

ORIGINATION FORM

Proposed Revisions to a Standard Plans Index
(Please provide all information – Incomplete forms will be returned)

Contact Information:

Date: July 31, 2019
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Standard Plans:

Index Number: 536-001
Sheet Number (s): 1-3,5-9,11-21,23,24
Index Title: Guardrail

Summary of the changes:

See Page 2 for summary of the changes.

Commentary / Background:

-Flared Approach Terminals are removed due to lack of manufacturer options with MASH compliance
-Modified Thrie-Beam is being removed because it is MASH TL-3 compliant, but the department has simpler options with MASH TL-3 requirements and reduced deflection

Other Affected Offices / Documents: (Provide name of responsible personnel)

Yes	No	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Other Standard Plans –
<input checked="" type="checkbox"/>	<input type="checkbox"/>	FDOT Design Manual – Richard Stepp, James McGinnis
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Basis of Estimates Manual –
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Standard Specifications –
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Approved Product List –
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Construction –
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Maintenance –

Origination Package Includes: (Email or hand deliver package to Derwood Sheppard)

Yes	N/A	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Redline Mark-ups
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Proposed Standard Plan Instructions (SPI)
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Revised SPI
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Other Support Documents

Implementation:

Design Bulletin (Interim) DCE Memo Program Mgmt. Bulletin FY-Standard Plans (Next Release)

Contact the Roadway Design Office for assistance in completing this form

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Standard Plans:

Index Number: 536-001

Sheet Number (s): 1-3,5-9,11-21,23,24

Index Title: Guardrail

Summary of the changes:

All Sheets: renumber to "of 24" for addition of two new Sheets (14 and 16)

Sheet 1: added new Sheet 14,16, & Trailing End Transition Connection to Rigid Barrier to Table of Contents; removed flared approach terminal from TOC; Note 10, allow for single-reduced post spacing for connections to existing guardrail

Sheets 2 & 3: removed modified thrie beam from Note 8

Sheet 5: removed modified thrie beam details and Note 5; added single-faced to double-faced guardrail connection detail

Sheet 6: removed modified thrie beam section and post information from table

Sheet 7: removed flared approach terminal; added note 6 "clear area requirement"; added approach terminal callout at begin/end guardrail location; added new information to note 5 to allow substitution for miscellaneous asphalt pavement placed upstream of post 1.

Sheet 8: removed mention of flare from note 7; added note 7, "Clear Area Requirement"; added approach terminal callout at begin/end guardrail location; added new Note 8 to allow substitution for miscellaneous asphalt pavement placed upstream of post 1.

Sheet 9: added trailing anchorage callout to begin/end guardrail station location

Sheet 11 & 12: added CRT End Treatment callout to Begin/End Guardrail Station location

Sheet 13: changed default curb option shown to "flush shoulder option", added TL-3 approach transition callout at begin/end GR. location

Sheet 14: (new sheet): added full TL-3 Approach Transition Connection layout for both curb continuation options; show guardrail tapers

Sheet 15 (previously 14): changed default curb option shown to "flush shoulder option"; added TL-2 approach transition callout at begin/end GR. location

Sheet 16 (new sheet): show full TL-2 Approach Transition Connection layout for both curb continuation options; show guardrail tapers

Sheet 17: (previously 15): updated alignment curb dimensions for best fit; Changed section view lettering to match new plan view options. Changed "flat no curb" option to "flush shoulder" option

Sheet 18 (previously 16): added Approach transition connection callout at begin/end guardrail station

Sheet 19 (previously 17): terminal updated from flared to parallel in plan view; added approach transition callout at begin/end guardrail location

Sheet 20 (previously 18): added approach transition callout at begin/end guardrail location

Sheet 21 (previously 19): terminal updated from flared to parallel in plan view

Sheet 23 (previously 21): updated Frangible Leave-out details to show steel post; changed Note 1 to explain that only steel posts are permitted

Sheet 24 (previously 22): removed modified thrie beam from Button-Head Bolt Length table.

SHEET	CONTENTS
1	General Notes; Index Contents
2	General, TL-3 Guardrail - Installed Plan and Elevation
3	Low-Speed, TL-2 Guardrail - Installed Plan and Elevation
4	W-Beam and Thrie-Beam Panel Details
5	Post and Offset Block Details
6	Guardrail Sections - Heights and Adjacent Slopes
7	End Treatment - Approach Terminal Geometry, Parallel and Flared
8	End Treatment - Approach Terminal Geometry, Curbed and Double Faced
9	End Treatment - Trailing Anchorage
10	End Treatment - Component Details
11	End Treatment - Controlled Release Terminal (CRT) System
12	Layout for CRT System - Side Roads and Driveways
13	Approach Transition Connection to Rigid Barrier - General, TL-3
14	Approach Transition Connection to Rigid Barrier - Low-Speed, TL-2
15	Approach Transition Connection to Rigid Barrier - Details
16	Approach Transition Connection to Rigid Barrier - Double Faced Guardrail
17	Layout to Rigid Barrier - Approach Ends
18	Layout to Rigid Barrier - Approach Ends with Double Faced Guardrail Layout to Rigid Barrier - Trailing Ends
19	Rub Rail Details
20	Pedestrian Safety Treatment - Pipe Rail
21	Modified Mount - Special Steel Post for Concrete Structure Mount; Modified Mount - Encased Post for Shallow Mount; Modified Mount - Frangible Leave-Out for Concrete Surface Mount
22	Barrier Delineators - Post Mounted; Clear Space - Reduced Post Spacing for Hazards; 5/8" Button-Head Bolt System

Table of Contents:

-Added new Sheet 14 & 16 for Approach Transition Connection to Rigid Barrier, renumbered as required

-Added "Trailing End Transition Connection to Rigid Barrier" to new Sheet 20

-Removed Flared Approach Terminal from Sheet 7

Added option for a single reduced post space at connection to make midspan panel splice connection

GENERAL NOTES:

1. **INSTALLATION:** Construct guardrail in accordance with Specification 536.

This Index, along with the plans and the manufacturers' drawings on the Approved Products List (APL), is sufficiently detailed for installation of General Guardrail, Low-Speed Guardrail, End Treatment assemblies, and their connecting options shown herein. This precludes requirements for shop drawing submittals unless otherwise specified in the plans.

2. **COMPATIBILITY:** The General Guardrail in this Index is based on the Midwest Guardrail System (MGS) design, with an approximate height of 31" at the top of the Panel (2'-1" mounting height at vertical \bar{C} of Panel) and a midspan panel splice as shown on Sheet 2. Guardrail components included on the APL, which are compatible with this Index, may also be identified as 31" or MGS Guardrail.

3. **STANDARD COMPONENTS:** Standard guardrail components, including posts, panels, and bolt systems, are based upon English unit conversions of the AASHTO-AGC-ARTBA Joint Committee Task Force 13 Report: A Guide to Standardized Highway Barrier Hardware (<http://www.aashtotf13.org/Barrier-Hardware.php>).

4. **BUTTON-HEAD BOLTS:** Install Button-Head Bolts where indicated using bolts, nuts, and washers as defined on Sheet 22. Place washers under nuts. Do not place washers between bolt heads and panels, except where otherwise shown in this Index.

5. **HEX-HEAD BOLTS:** Install Hex-Head Bolts where indicated using bolts, nuts, and washers in accordance with material properties of Specification 967. Place washers under nuts.

6. **MISCELLANEOUS ASPHALT PAVEMENT:** Install Miscellaneous Asphalt Pavement where indicated with a tolerance of $\pm 1/2$ " depth and in accordance with Specification 339.

7. **ADJACENT SIDEWALKS & SHARED USE PATHS:** When guardrail posts are placed within 4'-0" of a sidewalk or shared use path, use timber posts, or use steel posts only if treated with Pipe Rail as shown on Sheet 20.

When timber posts are used, one of the following safety treatments is required for the bolt(s) protruding from the back face of the posts:

- a. After tightening the nut, trim the protruding post bolt flush with the nut and galvanize per Specification 562.
- b. Use post bolts 15" in length and countersink the washer and nut between 1" and 1 1/2" deep into the back face of the post.
- c. Use 15" post bolts with sleeve nuts and washers.

When End Treatment posts are within 4'-0" of a sidewalk or shared use path, steel posts are not permitted within the End Treatment segment. Terminate the Pipe Rail outside of End Treatment segments, as noted per Sheet 20.

8. **NESTED W-BEAM:** Where called for in the plans, install two W-Beam Panels mounted flush per location, securing all panels with Button-Head Bolts threaded through aligned slots and holes. 2" Button-Head Bolts are permitted for panel splice locations.

9. **CONNECTION TO RIGID BARRIER:** The connections to Rigid Barrier in this Index only apply to newly constructed bridge Traffic Railing and Concrete Barrier or where the complete Approach Transition Connection to Rigid Barrier shown herein can be installed without conflicting with existing Traffic Railings, structures, or approach slabs.

For connecting guardrail to existing bridge Traffic Railings, see the layouts and details of Indexes 536-002, 521-404, and 421-405.

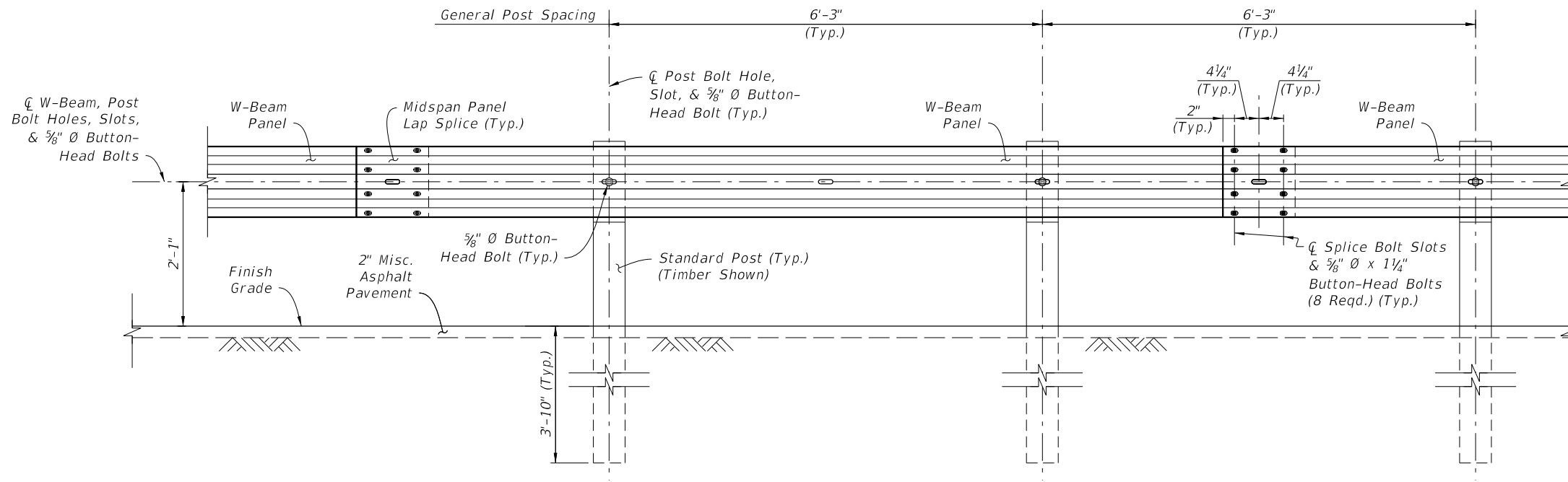
10. **CONNECTION TO EXISTING GUARDRAIL:** Where a transition to existing guardrail at 27" height is required, linearly transition the guardrail height over a distance ranging from 25'-0" to 31"-3". Provide an immediate transition to the required midspan splice using the available panel options on Sheet 4 (9'-4 1/2" or 15'-7 1/2" panel).

11. **PLANS CALLOUTS:** Begin/End Station labels are shown throughout this Index as they correspond to the station and offset callouts specified in the plans.

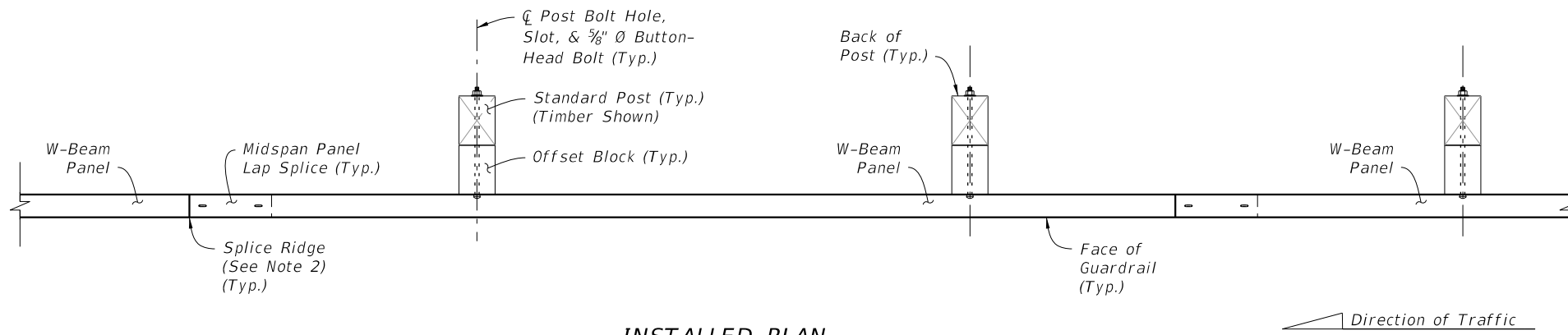
In the plans, Begin/End Guardrail Station refers to the General TL-3 Guardrail Pay Item, and it may be abbreviated as Begin/End GR. Station. Where the Low-Speed TL-2 Guardrail Pay Item is specifically required, the callout in the plans will then specify Begin/End TL-2 GR. Station.

12. **QUANTITY MEASUREMENT:** Measure guardrail and corresponding components as defined in Specification 536. The Guardrail length is measured along the centerline of installed Panels, between the points labeled Begin/End Guardrail Station shown on the following Index Sheets and defined in the plans (typically measured from the \bar{C} of the panel's post bolt slots at the approach/trailing ends).

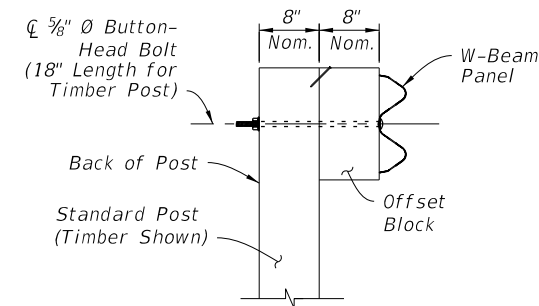
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GENERAL GUARDRAIL
INSTALLED ELEVATION



INSTALLED PLAN



INSTALLED SECTION

NOTES:

- GENERAL: Install the General Guardrail configuration where indicated in the plans. This may include tapered segments if called for in the plans.

Use 12'-6" or longer W-Beam Panels. A single 6'-3" Panel may be used at the end of the run to meet the nominal Begin/End Guardrail Sta. requirements.

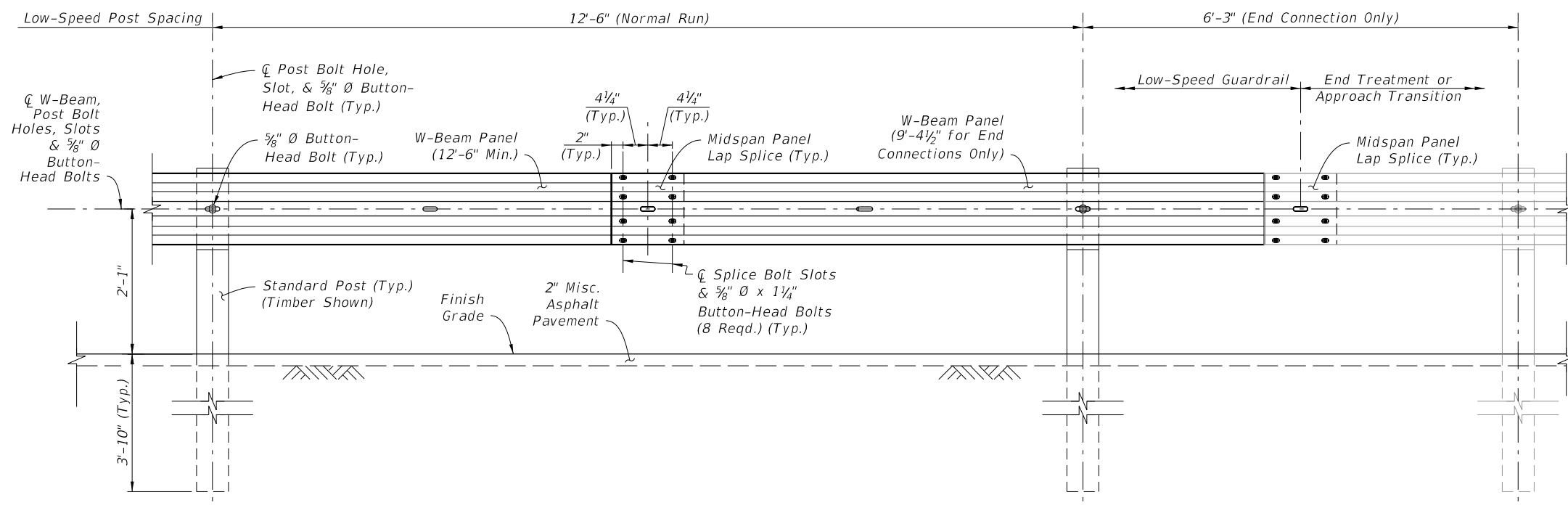
Where a differing guardrail configuration is required for constructability beyond the options shown in this Index or the plans, obtain approval from the Engineer prior to installation.
- MIDSPAN PANEL LAP SPLICE: For proper structural function, place all Lap Splices at midspan unless otherwise indicated.

Lap the Panels with the Splice Ridge oriented downstream of the final Direction of Traffic in the nearest traffic lane. For reverse lane conditions, orient the Splice Ridge downstream of the lane direction with the highest traffic volume. Orienting Lap Splices for Temporary Traffic Control phasing is not required.
- CONNECTION DETAILS: Connections to End Treatments, Approach Transitions, or other segment types are defined in the following Index Sheets, APL Drawings, or the plans.
- W-BEAM PANEL DETAILS: See Sheet 4.
- POST & OFFSET BLOCK DETAILS: See Sheet 5.
- GUARDRAIL SECTIONS: For Sections showing typical mounting heights, grading, and lateral offsets in relation to adjacent roadway features, see Sheet 6.
- MODIFIED MOUNTS: Where concrete structures, concrete sidewalk, or shallow depth conditions are encountered, see Sheet 21 for additional post mounting options.
- DEFINED SEGMENTS: The General Guardrail shown provides the base configuration, including Post Spacing and splice locations, for Defined Segment modifications where indicated in the plans and using the Guardrail Types, Sections, and/or hardware as shown in this Index (e.g. Double Faced W-Beam, ~~Modified Triple Beam~~, Deep Posts at Slope Breaks, Pipe Rail, Rub Rail, or Reduced Post Spacing for Hazards).

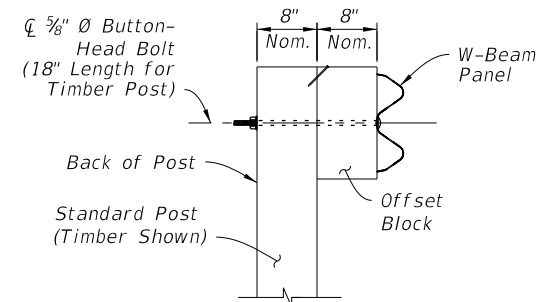
GENERAL, TL-3 GUARDRAIL DETAILS

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LAST REVISION	DESCRIPTION:		FY 2019-20 STANDARD PLANS	GUARDRAIL	INDEX	SHEET
11/01/17	11/01/19				536-001	2 of 22-24



LOW-SPEED GUARDRAIL
INSTALLED ELEVATION



INSTALLED SECTION

NOTES:

1. GENERAL: Install the Low-Speed Guardrail configuration where indicated in the plans. Low-Speed Guardrail may include tapered segments if called for in the plans.

Use 12'-6" or 25'-0" W-Beam Panels for normal spans, and use 9'-4 1/2" Panels for end connections to adjoining segments as shown. A single 6'-3" Panel may be used at the end of the Low-Speed Guardrail run along with a single reduced 6'-3" post spacing to meet the nominal Begin/End Guardrail Sta. required.

Where a differing guardrail configuration is required for constructability beyond the options shown in this Index or the Plans, obtain approval from the Engineer prior to installation.

2. MIDSPAN PANEL LAP SPLICE: For proper structural function, place all Lap Splices at midspan unless otherwise indicated.

Lap the Panels with the Splice Ridge oriented downstream of the final Direction of Traffic in the nearest traffic lane. For reverse lane conditions, orient the Splice Ridge downstream of the lane direction with the highest traffic volume. Orienting Lap Splices for Temporary Traffic Control phasing is not required.

3. CONNECTION DETAILS: Connections to End Treatments, Approach Transitions, or other segment types are defined in the following Index Sheets, APL Drawings, or the plans.

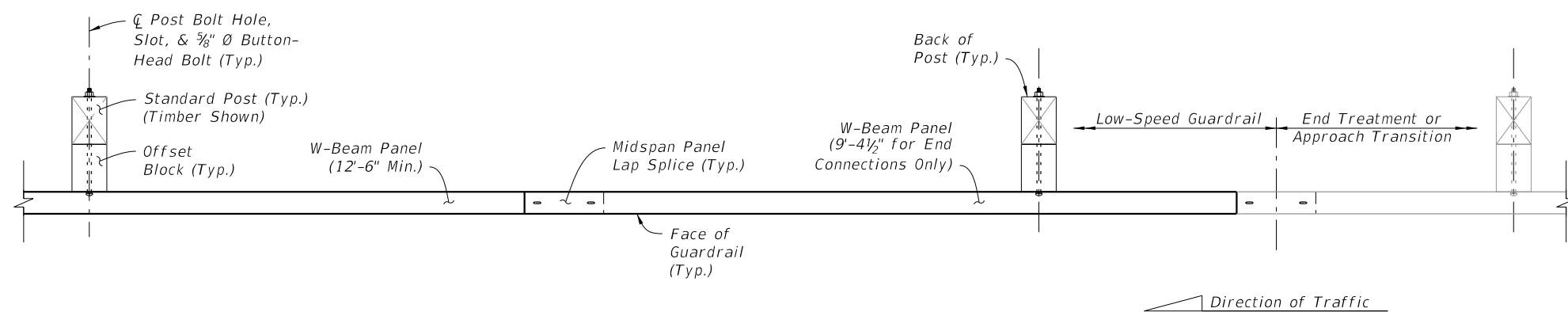
4. W-BEAM PANEL DETAILS: See Sheet 4.

5. POST & OFFSET BLOCK DETAILS: See Sheet 5.

6. GUARDRAIL SECTIONS: For Sections showing typical mounting heights, grading, and lateral offsets in relation to adjacent roadway features, see Sheet 6.

7. MODIFIED MOUNTS: Where concrete structures, concrete sidewalk, or shallow depth conditions are encountered, see Sheet 21 for additional post mounting options.

8. RESTRICTIONS: Low-Speed Guardrail segments are not permitted for use with items including, but not limited to, Double Faced W-Beam, ~~Modified Timber Beam~~, Deep Posts at Slope Breaks, Pipe Rail, and/or Rub Rail.



INSTALLED PLAN

LOW-SPEED, TL-2 GUARDRAIL DETAILS

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11/01/17	
11/01/19	

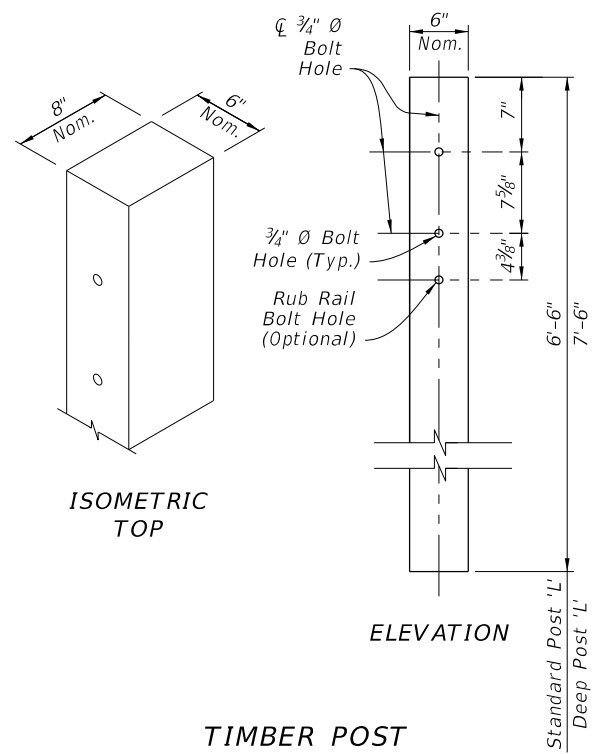


FY 2019-20
STANDARD PLANS

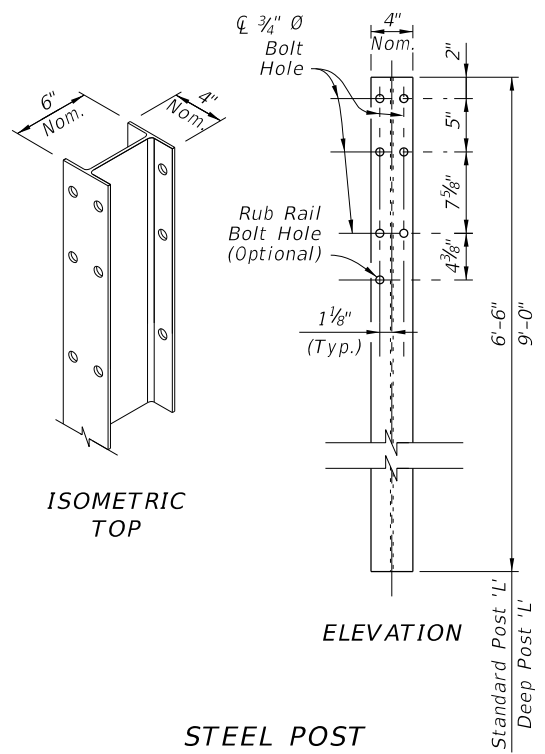
GUARDRAIL

INDEX
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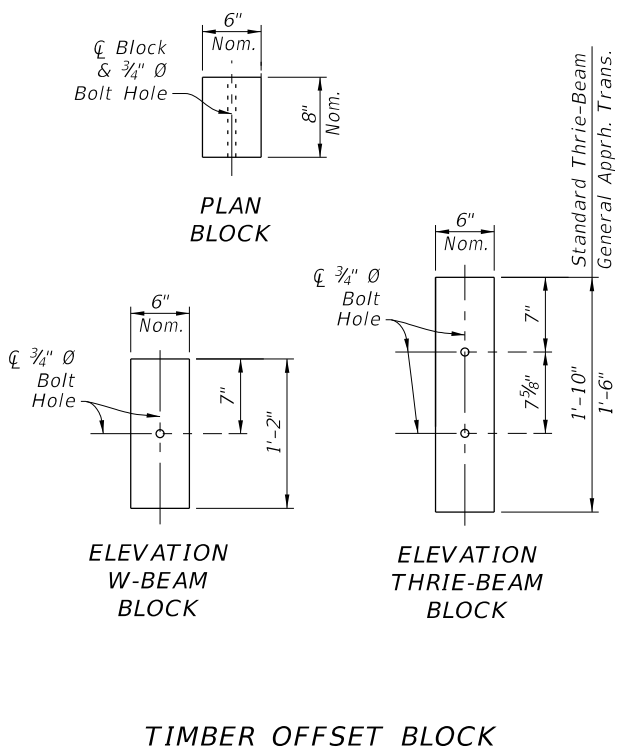
SHEET
3 of 22-24



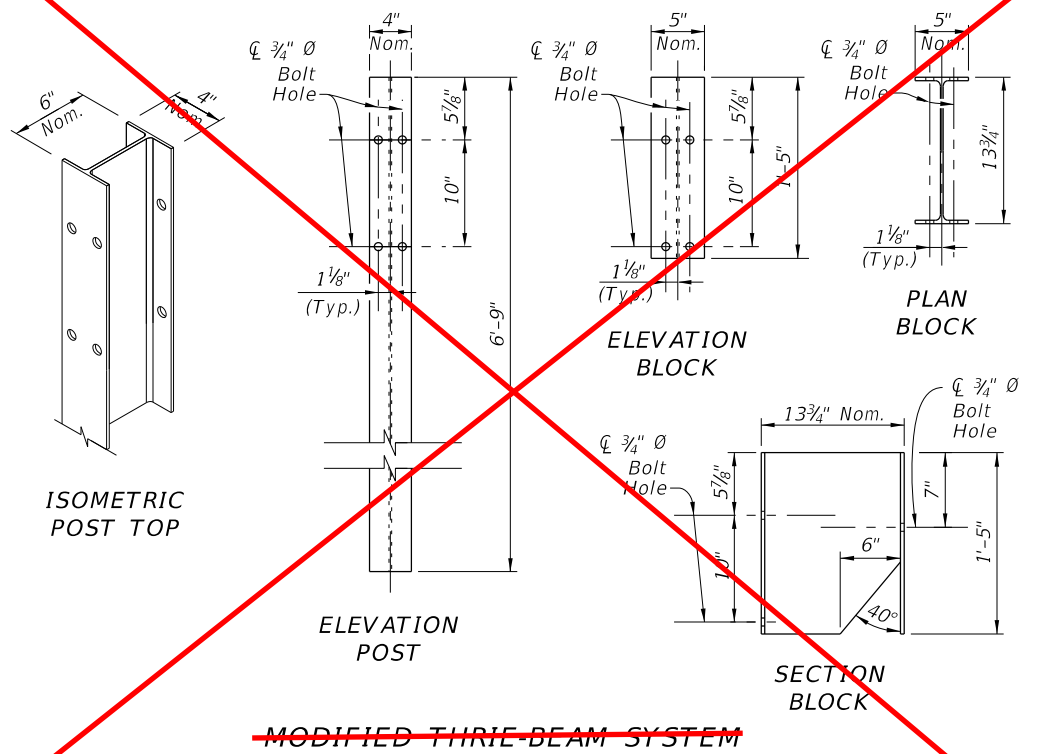
TIMBER POST
(6" X 8" Nominal)



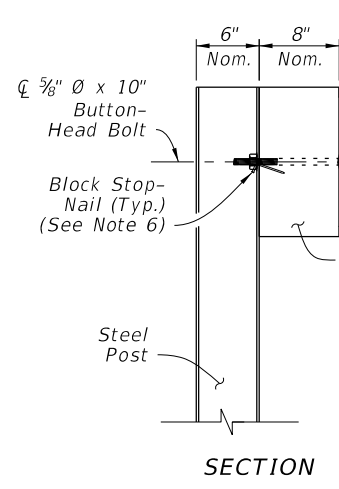
STEEL POST
(W6X8.5 or W6X9)



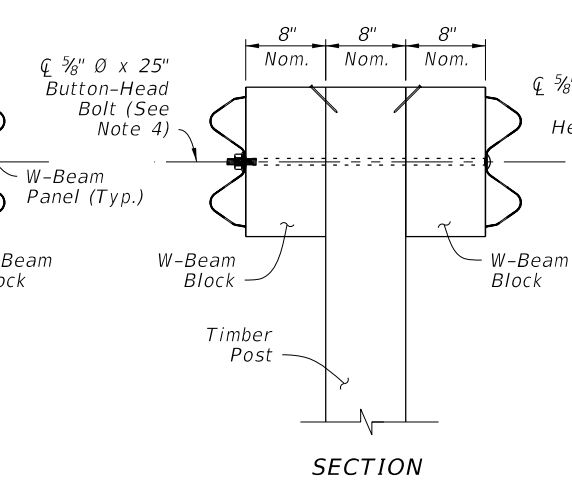
TIMBER OFFSET BLOCK
(6" X 8" Nominal)



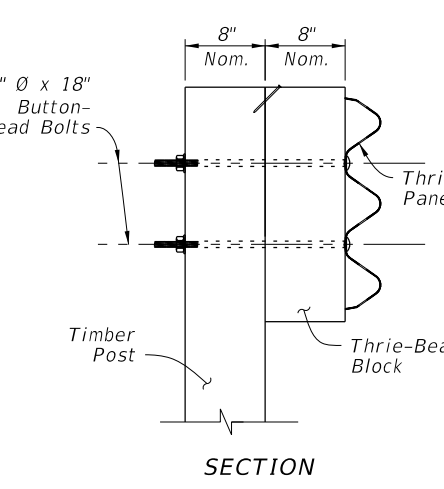
~~**MODIFIED THRIE-BEAM SYSTEM**
(W6X8.5 or W6X9 Steel Post & W14X22 Steel Block)~~



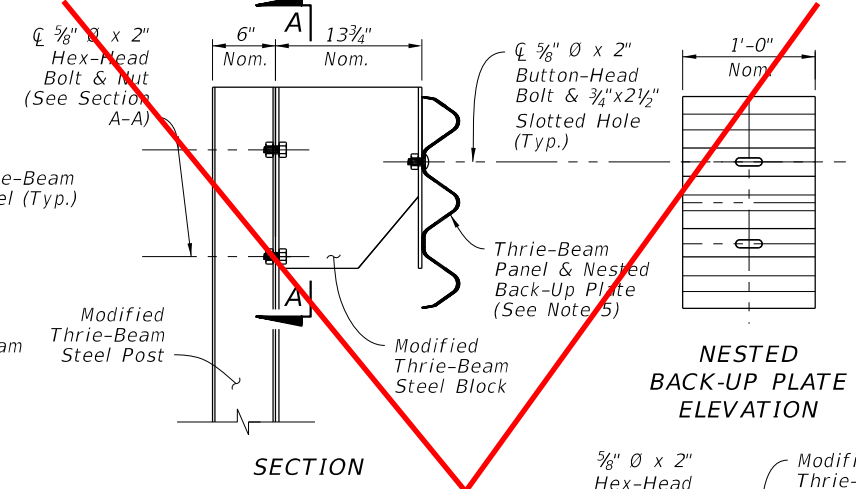
W-BEAM STEEL POST
(Timber Post Similar)



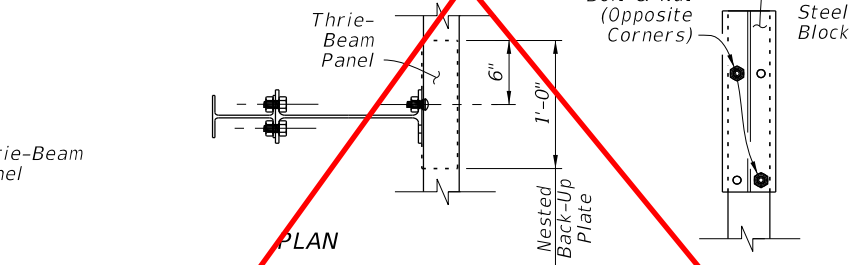
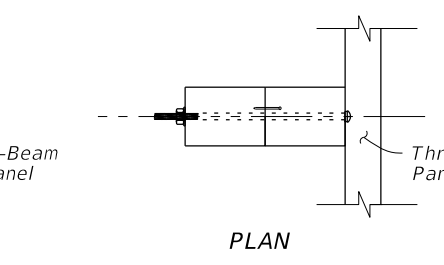
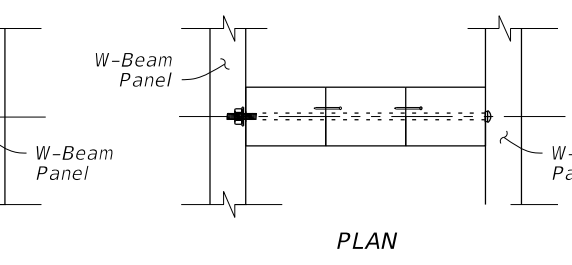
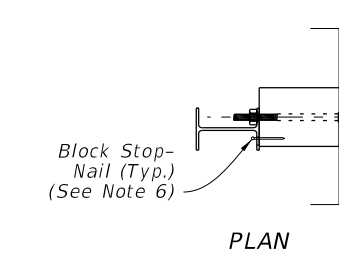
DOUBLE FACED W-BEAM TIMBER POST
(Thrie-Beam Similar)
(Steel Post Similar)



THRIE-BEAM TIMBER POST
(Steel Post Similar)



~~**MODIFIED THRIE-BEAM**
(Steel Post Only)~~

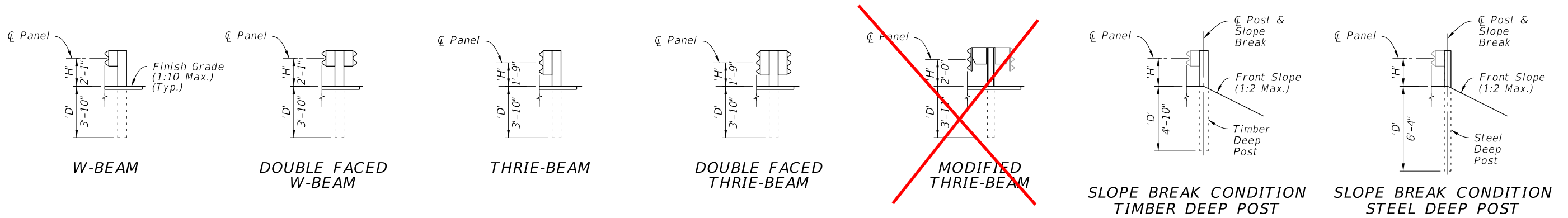


- NOTES:**
- 1. STANDARD ~~DOUBLE FACE~~ connection details are called for in this Index, except as noted. Use a single post at the Length, 'L', shown for Standard Posts. Use a single post material type consistently per each run of guardrail. Only where specified in the Plans, use the Deep Post 'L' for Slope Break Conditions as shown on Sheet 6.
 - 2. OFFSET BLOCKS: For each Panel type, install the corresponding Offset Block type as shown. For General, TL-3 (Single Faced) Approach Transitions only, use the 1'-6" Thrie-Beam Block (See Sheet 13).
 - 3. BOLT HOLES: 3/4" Ø Bolt Holes shown in posts within this Index may be substituted with 13/16" Ø Bolt Holes.
 - 4. DOUBLE FACED GUARDRAIL: Orient Post Bolts with the Button-Head located on the side nearest the traffic lane. The bolt's threaded portion is not permitted to extend beyond 3/4" from the face of the tightened nut; trim the threaded portion as needed and galvanize in accordance with Specification 562.
 - 5. ~~MODIFIED THRIE-BEAM NESTED BACK-UP PLATE: At each post connection, install a Nested Back-Up Plate between the Thrie-Beam Panel and the post. The Nested Back-up Plate has a cross-section and material matching the Thrie-Beam Panel Section.~~
 - 6. BLOCK STOP-NAIL: Drive one nail per Standard Offset Block as shown to prevent Block rotation. Use steel 3 1/2" Type 16d nails with ASTM A153 hot-dip galvanization. For steel posts, drive the nail through the unused flange Bolt Hole and bend the nail so its head contacts the flange.
 - 7. MATERIALS: Use timber and steel posts and offset blocks in accordance with Specification 967. Composite offset blocks may be substituted as approved on the APL. Use a single offset block type consistently per each run of guardrail. Steel offset blocks are only permitted for Modified Thrie Beam.

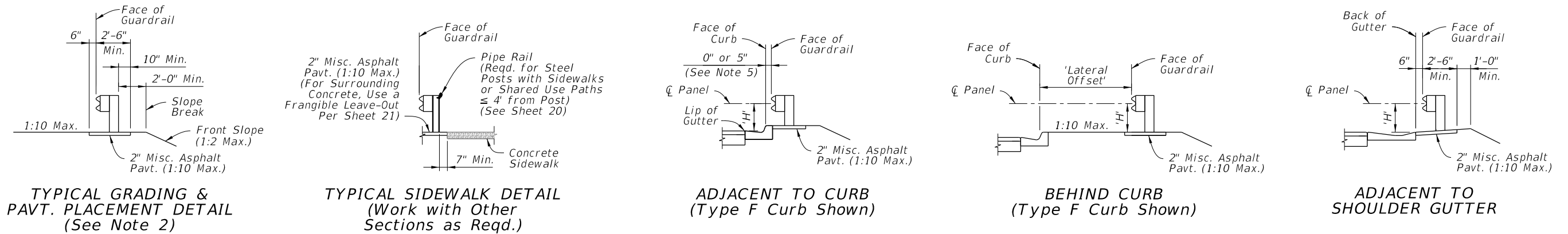
POST AND OFFSET BLOCK DETAILS

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11/01/17	11/01/19

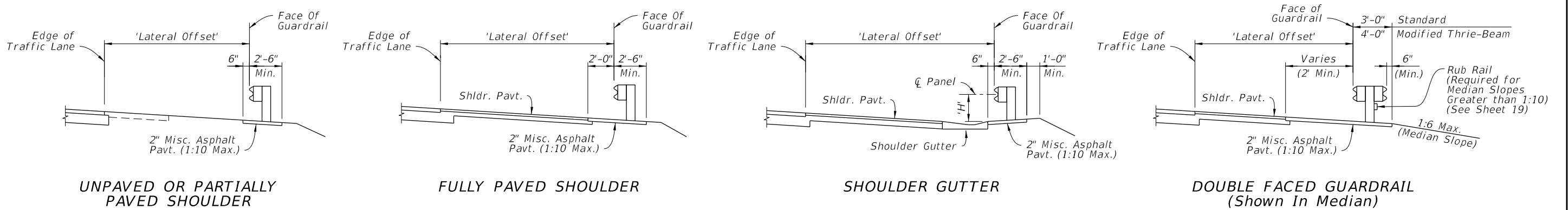


GUARDRAIL TYPES - MOUNTING HEIGHTS & POST DEPTHS



GUARDRAIL SECTIONS - TYPICAL

GUARDRAIL SECTIONS - CURB & GUTTER



GUARDRAIL SECTIONS - SHOULDERS

GUARDRAIL HEIGHT SUMMARY TABLE:			
Type:	Min. Depth 'D':	Mounting Height 'H':	Post Length 'L':
W-Beam (Single and Double Faced)	3'-10"	2'-1"	6'-6"
Thrie-Beam (Single and Double Faced)	3'-10"	1'-9"	6'-6"
Modified Thrie-Beam	3'-11"	2'-0"	6'-9"
Timber Deep Post	4'-10"	See Above	7'-6"
Steel Deep Post	6'-4"	See Above	9'-0"

NOTES:

1. GUARDRAIL SECTIONS: Construct Sections as indicated in the plans. The details shown herein depict W-Beam Guardrail, but are applicable to the other defined Guardrail Types placed at the corresponding height, 'H'. Use components per Sheets 4 & 5. Steel and timber post types are interchangeable unless otherwise defined. The 1:10 Max. cross slope shown is the maximum slope permitted for proper guardrail function, but project-specific cross slope requirements are governed per the plans.
2. TYPICAL GRADING & PAVEMENT PLACEMENT DETAIL: Construct features as depicted except where superseded by specific Guardrail Sections or the plans. Place the Slope Break a Minimum of 2' behind the post. For Deep Posts, the slope break may be placed at the ϕ Post with the 2" Miscellaneous Asphalt Pavement omitted.
3. SLOPE BREAK CONDITION: Install Deep Posts only where called for in the plans. Deep Posts are only permitted where post spacing is 6'-3" or less.
4. LATERAL OFFSETS: The Lateral Offsets shown are governed by the station and offset call outs for Face of Guardrail, as shown in the plans.
5. ADJACENT TO CURB: Place the Face of Guardrail consistently offset either flush with the Face of Curb or 5" behind the Face of Curb, as indicated by the plans station and offset callout. For offset changes, transition the Face of Guardrail as shown in the plans.

GUARDRAIL SECTIONS

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11/01/17	11/01/17
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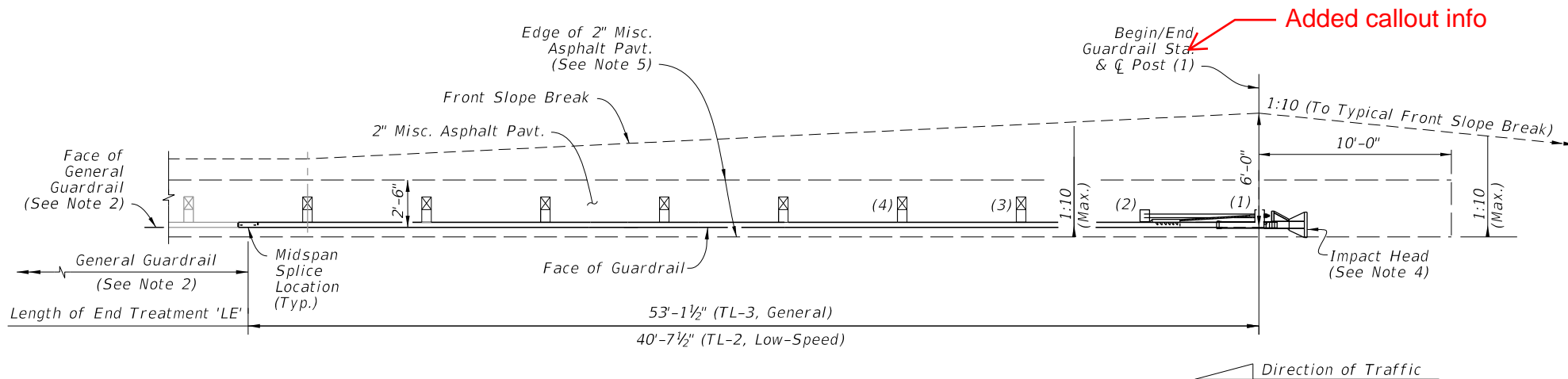


FY 2019-20
STANDARD PLANS

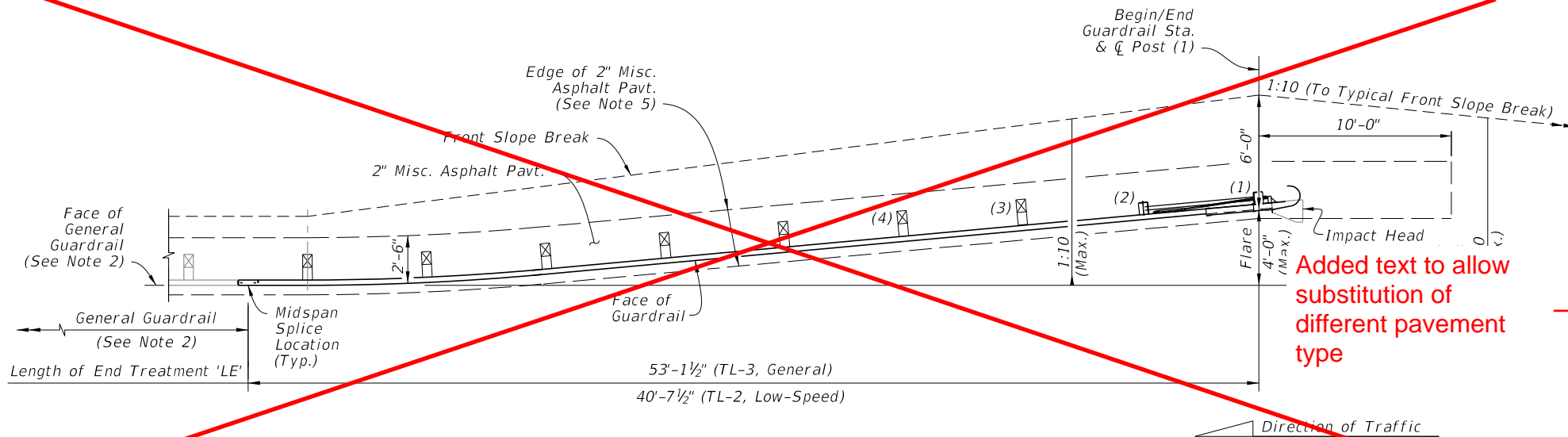
GUARDRAIL

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536-001

SHEET
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APPROACH TERMINAL ASSEMBLY
'PARALLEL' SEGMENT - PLAN VIEW



APPROACH TERMINAL ASSEMBLY
'FLARED' SEGMENT - PLAN VIEW

NOTES:

1. INSTALLATION: Locate Approach Terminals where called for in the plans, with the Post (1) C Post placed at the Begin/End Guardrail Station indicated in the plans.

The Plan Views shown herein are schematic only, showing basic geometry for Approach Terminals listed on the APL. The predefined Length of End Treatment, 'LE', includes the proprietary portion of various Approach Terminals and provides for more consistent planning of assembly installations across the differing Approach Terminal types. Forward-anchoring style Approach Terminals may vary from the planned lengths shown by up to 3'-0".

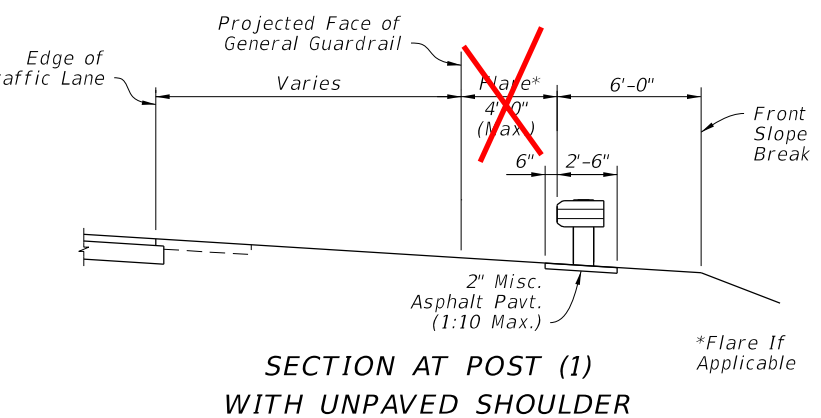
Construct Approach Terminals as shown in the APL and in accordance with the manufacturer's unique drawing details, procedures, and specifications.

Install posts in accordance with the manufacturer's drawings. The Special Posts on Sheet 21, including Special Steel Posts, Encased Posts, and Frangible Leave-Outs, are not permitted within the Approach Terminal segment unless otherwise called for in the plans.

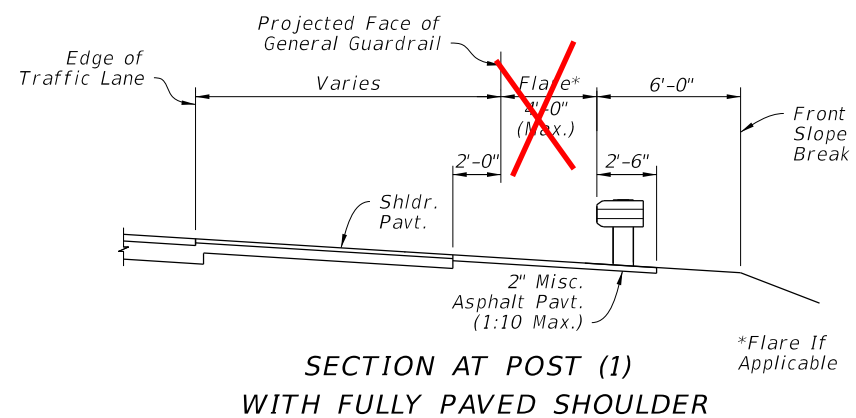
Align panel lap splices in accordance with the manufacturer's drawings, regardless of the direction of traffic.

Install adjacent grading, gutters, and/or curbing as shown herein, unless otherwise specified in the plans.
2. GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments.

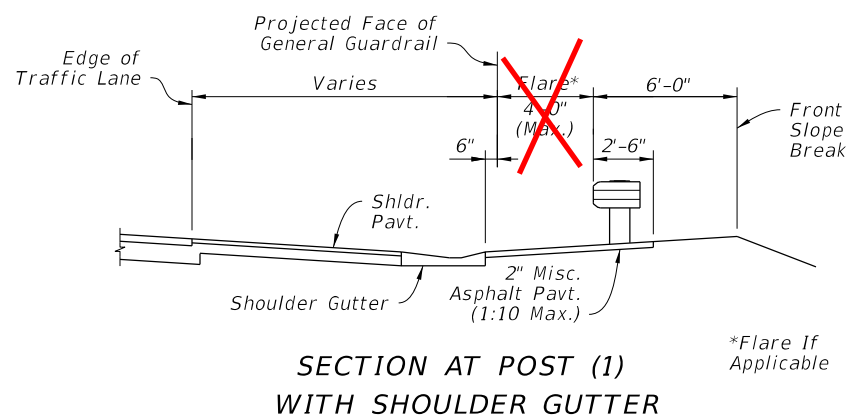
Approach Transitions, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.
3. APPROACH TERMINAL TEST LEVEL: Install either a Test Level 3 (TL-3) or Test Level 2 (TL-2) Approach Terminal as specified in the plans. TL-3 Approach Terminals may substitute for TL-2 Approach Terminals unless the substitution is specifically prohibited in the plans. TL-2 Approach Terminals may not substitute for TL-3 installations.
4. IMPACT HEAD END DELINEATOR: Apply Yellow Retroreflective Sheeting to the nose of the End Terminal in accordance with Specification 536.
5. 2" MISCELLANEOUS ASPHALT PAVEMENT: The Plan Views shown herein depict the Unpaved Shoulder condition. For Fully Paved Shoulder and Shoulder Gutter conditions, extend the 2" Misc. Asphalt Pavement as shown in the corresponding 'Section at Post (1)' details below.
6. 'CURBED' AND 'DOUBLE FACED' GUARDRAIL SEGMENTS: See Sheet 8.



SECTION AT POST (1)
WITH UNPAVED SHOULDER



SECTION AT POST (1)
WITH FULLY PAVED SHOULDER



SECTION AT POST (1)
WITH SHOULDER GUTTER

END TREATMENT -
APPROACH TERMINAL GEOMETRY
PARALLEL AND FLARED

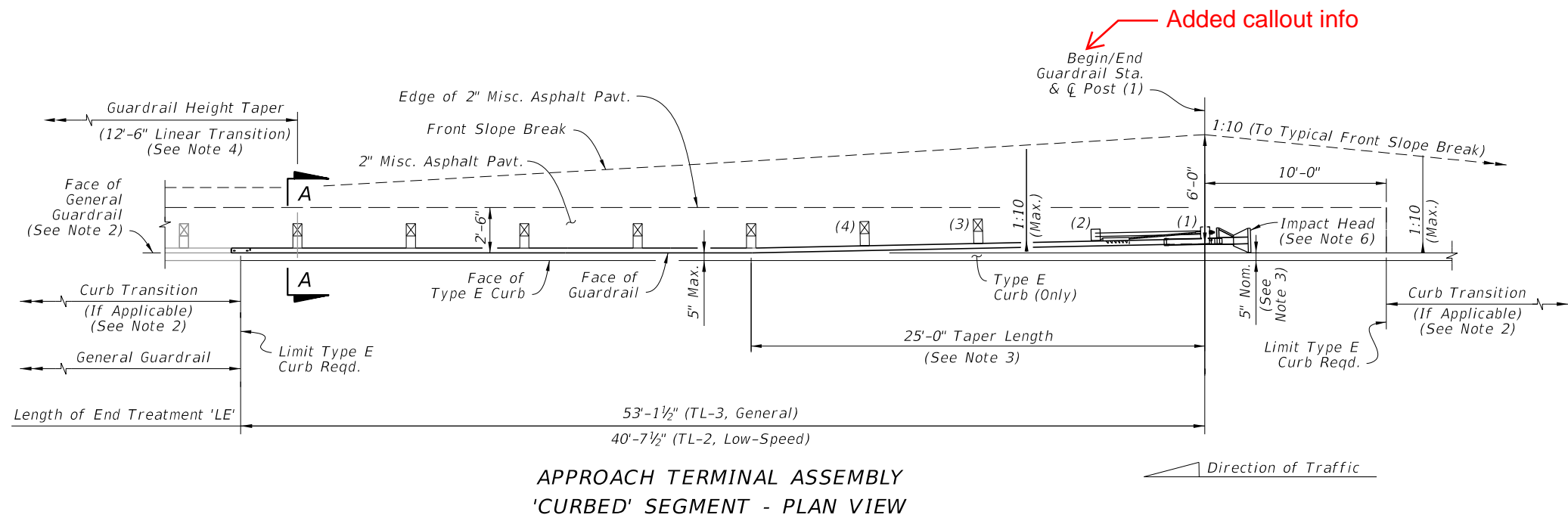
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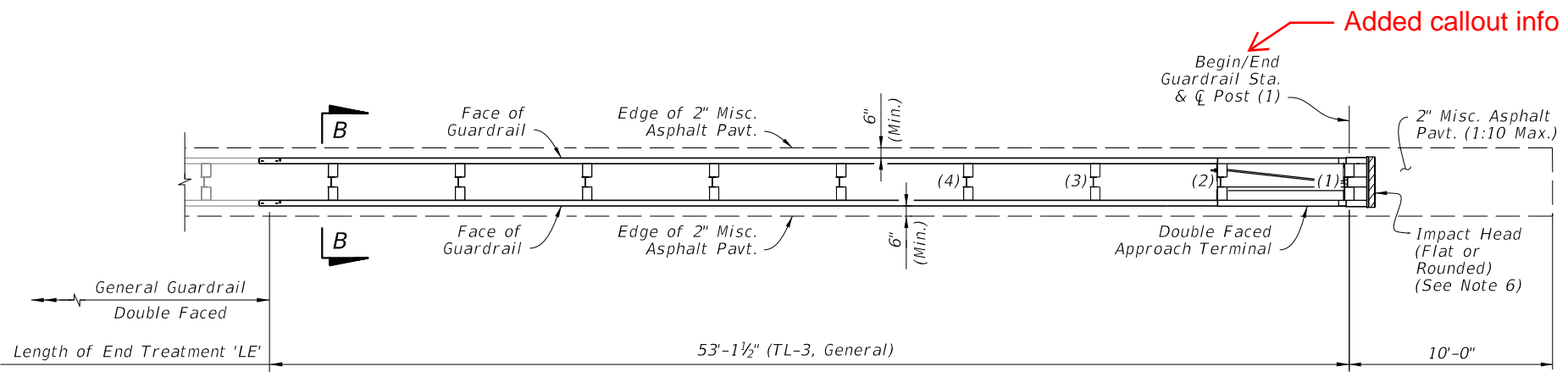
FDOT
FY 2019-20
STANDARD PLANS

GUARDRAIL

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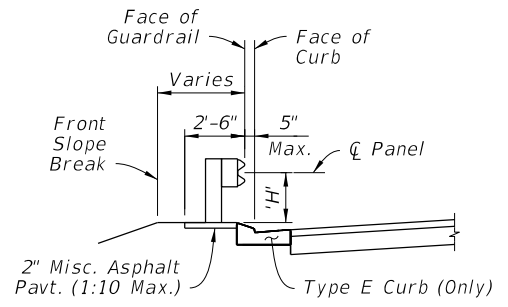


APPROACH TERMINAL ASSEMBLY
'CURBED' SEGMENT - PLAN VIEW

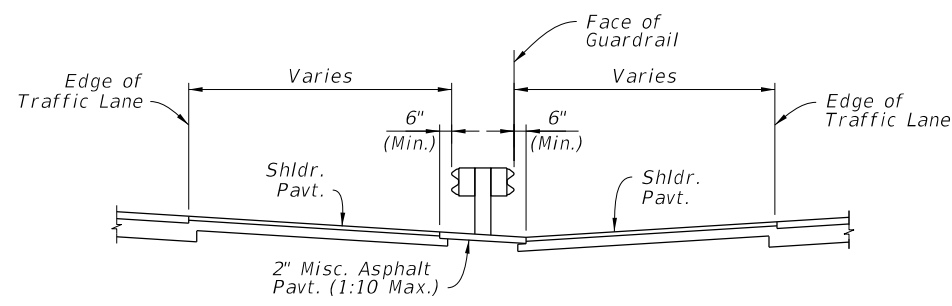


APPROACH TERMINAL ASSEMBLY
'DOUBLE FACED' SEGMENT - PLAN VIEW

Added note to allow substitution of different pavement type



'CURBED' SECTION A-A
(Height, 'H', Measured from Misc. Asphalt Pavt.)



'DOUBLE FACED' SECTION B-B
(1:10 Slope or Flatter Reqd.)

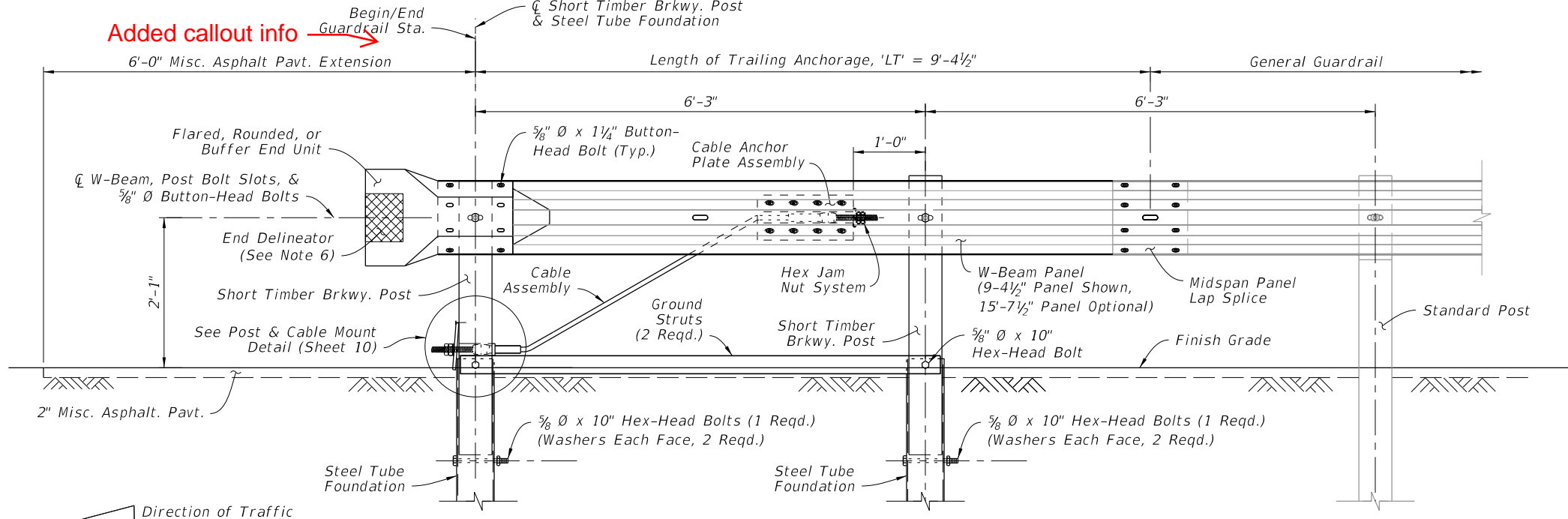
- NOTES:**
1. GENERAL: See Notes 1 through 3 on Sheet 7.
 2. CURBED SEGMENTS: Type E curb is required within the limits shown. When a different curb type is called for outside of the Type E curb limits, transition the curb shape linearly, over a nominal distance ranging 5'-0" to 10'-0"
 3. TAPER LENGTH: For Curbed Segments, taper the guardrail away from the roadway where shown to place the inside edge of the Impact Head at 5" behind the face of the curb. Where additional lateral offset is required to fit the Approach Terminal Assembly hardware, such as a soil plate, place the Impact Head as close to the curb as the hardware allows, not to exceed 2'-0" from the face of curb.
 4. GUARDRAIL HEIGHT TAPER: For Curbed Segments, the connecting General Guardrail Mounting Height, 'H', is typically measured from the Lip of Gutter (See Sheet 6 Guardrail Sections, 'Adjacent to Curb'), while the End Terminal Assembly 'H' is measured from the Misc. Asphalt Pavt. (See Section A-A). Linearly taper the difference in Mounting Height over a minimum length of 12'-6", starting where indicated herein.
 5. DOUBLE FACED SEGMENT: Connect to Double Faced General Guardrail. Use consistent Posts and Offset Block types as specified in the APL drawings over the entire Length of End Treatment, 'LE'. Posts and Offset Blocks in the adjoining General Guardrail segment may be different from those inside of the 'LE'. A change in post type between timber and steel is permitted, immediately outside of the 'LE' segment.

Maintain the 1:10 maximum grading as shown in Section B-B throughout segment 'LE'. Where required, transition to differing adjacent slopes linearly, over a minimum longitudinal length of 25'-0".
 6. IMPACT HEAD END DELINEATOR: Apply Yellow Retroreflective Sheeting to the nose of the End Terminal in accordance with Specification 536.
 7. SINGLE FACED 'PARALLEL' ~~AND 'FLARED' SEGMENTS~~: See Sheet 7.

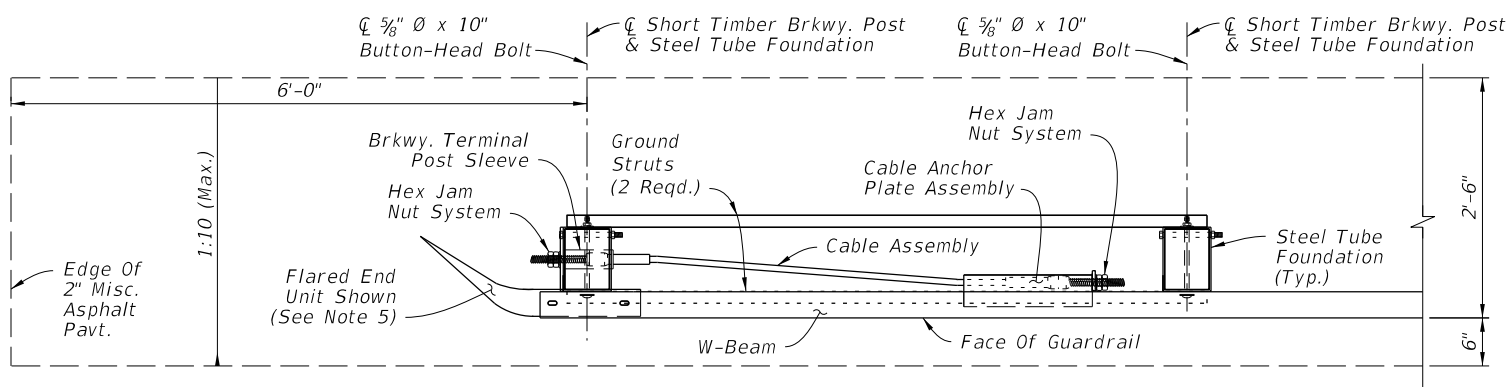
END TREATMENT -
APPROACH TERMINAL GEOMETRY
CURBED AND DOUBLE FACED

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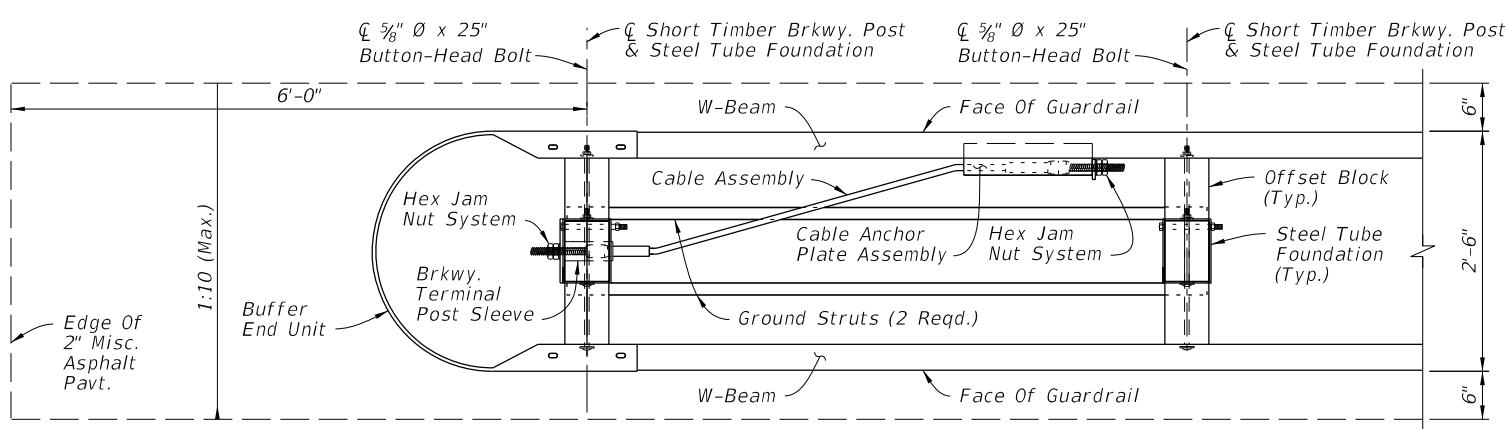
LAST REVISION 11/01/17	DESCRIPTION: 11/01/17 11/01/19	FDOT FY 2019-20 STANDARD PLANS	GUARDRAIL	INDEX 536-001	SHEET 8 of 22-24
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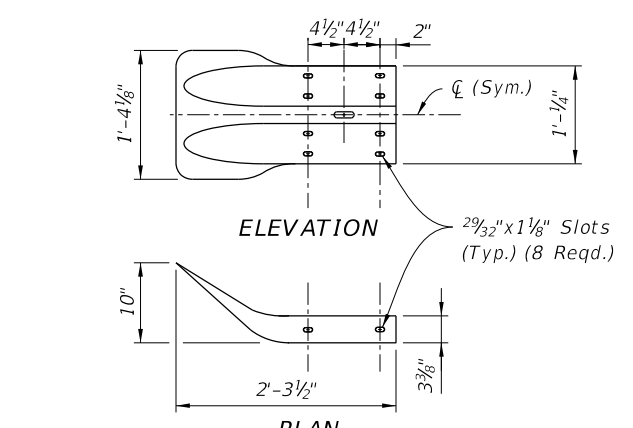
INSTALLED ELEVATION



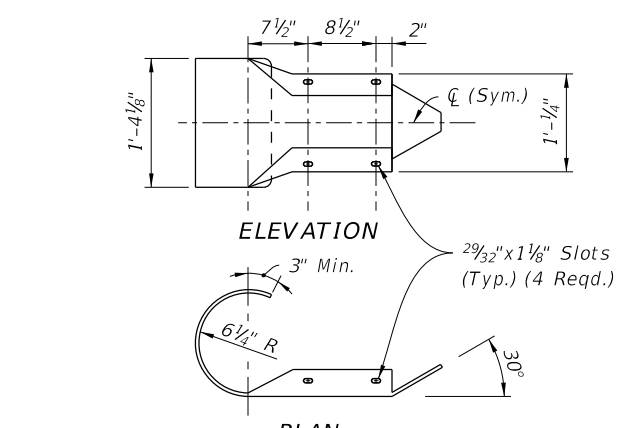
SINGLE FACE TRAILING ANCHORAGE
INSTALLED PLAN



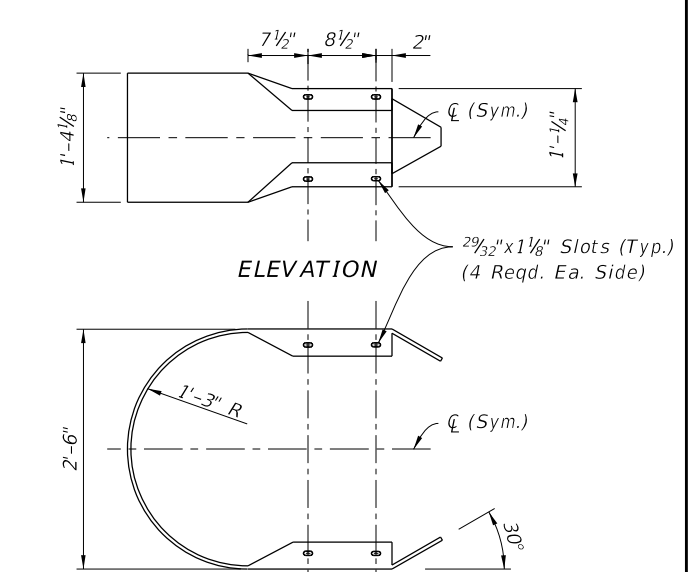
DOUBLE FACE TRAILING ANCHORAGE
INSTALLED PLAN



FLARED END UNIT



ROUNDED END UNIT



BUFFER END UNIT

NOTES:

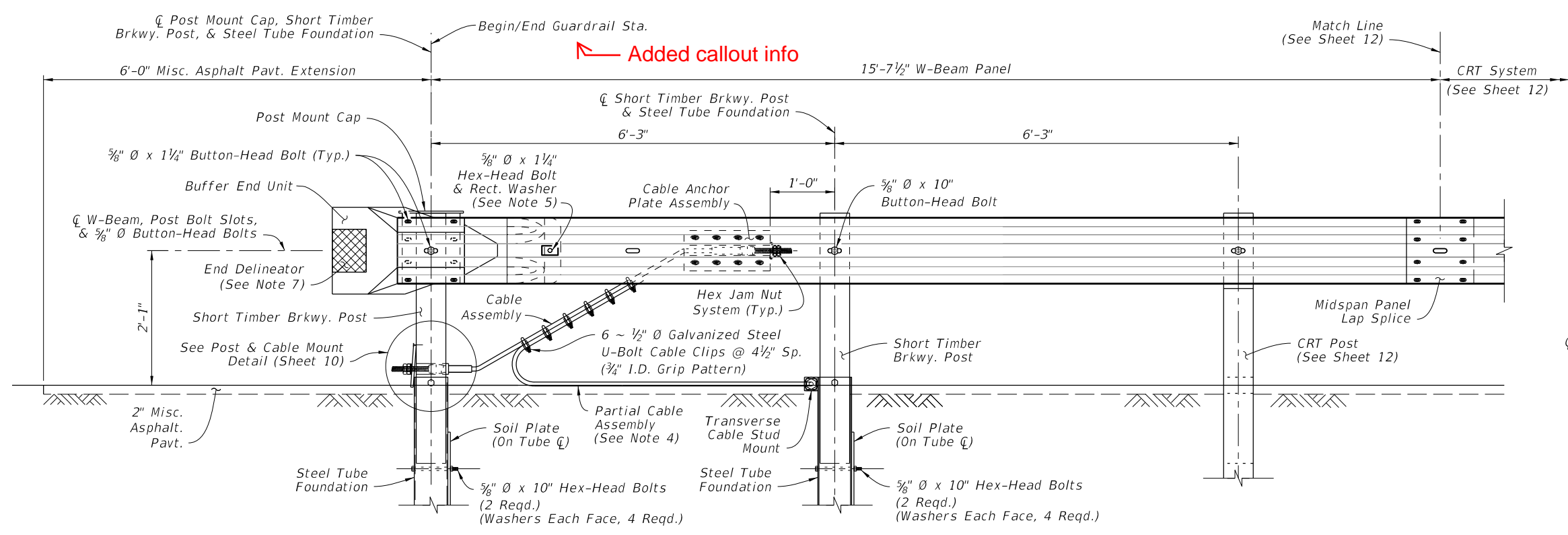
1. COMPONENT DETAILS: For additional component details, See Sheet 10.
2. END UNITS: Use materials for end units as defined in Specifications Section 967. End Units are referred to as "End or Buffer Sections" in AASHTO M180.
Lap the Flared End Unit behind the W-Beam; lap the Rounded and Buffered End Units over the face of the W-Beam.
3. FOUNDATIONS: Install Steel Tubes by either of the following methods:
 - a. Excavate, backfill, and compact material to provide full passive soil resistance to the surface of the Tube.
 - b. Drive the Tube using a dummy timber post to prevent damage to the Breakaway Post.
4. GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Transitions, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.
5. SIDEWALK REQUIREMENTS: When sidewalks are located adjacent to the End Treatment, install a Rounded End Unit (Flared End Unit not permitted for this case).
6. END DELINEATOR: Mount retroreflective sheeting to the approach face of the End Unit in accordance with Specification Sections 536 and 967.

END TREATMENT - TRAILING ANCHORAGE

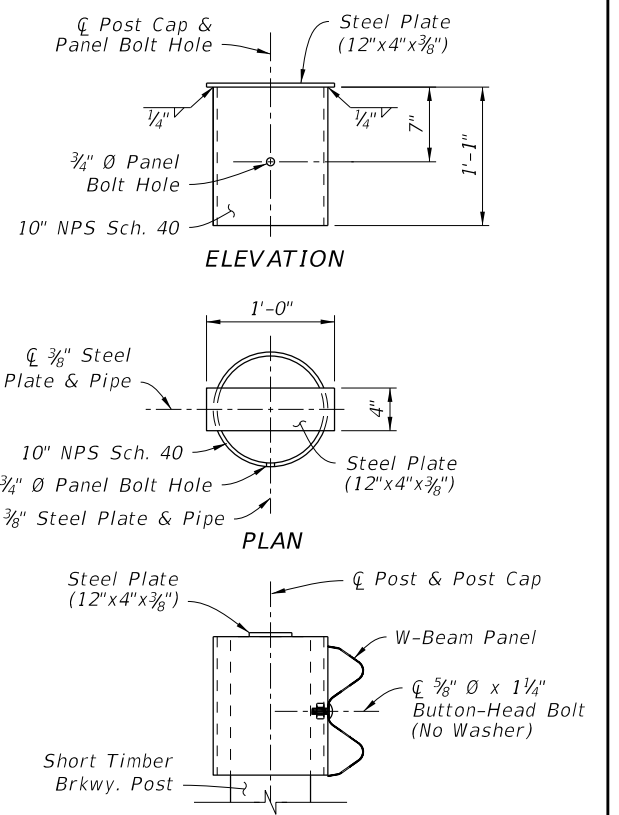
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LAST REVISION	DESCRIPTION:
11/01/18	11/01/19

Added callout info



INSTALLED ELEVATION

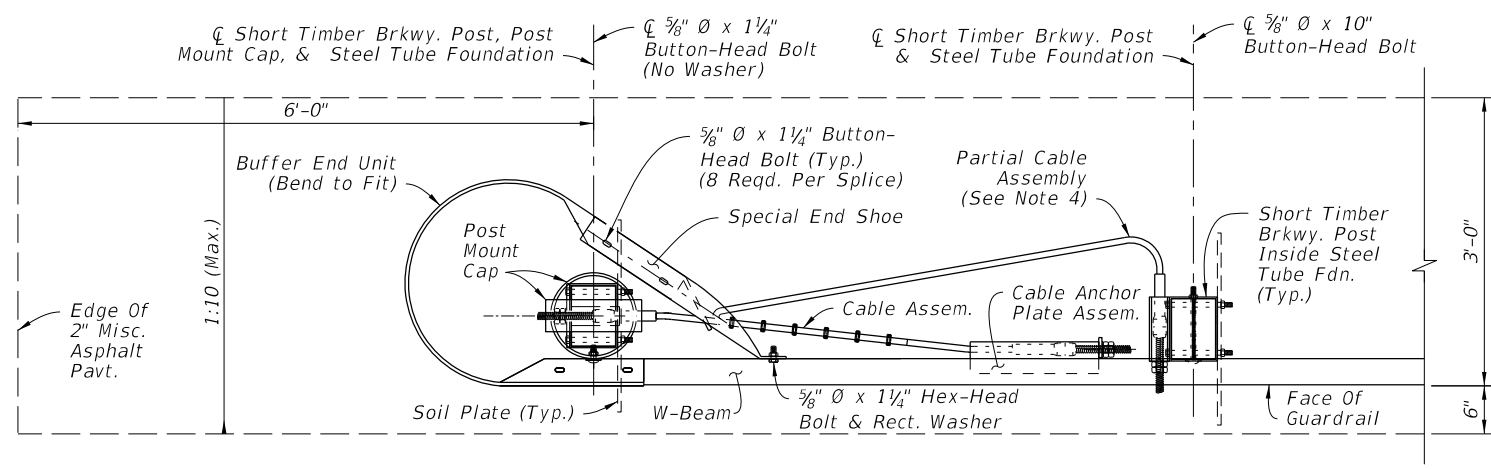


ELEVATION

PLAN

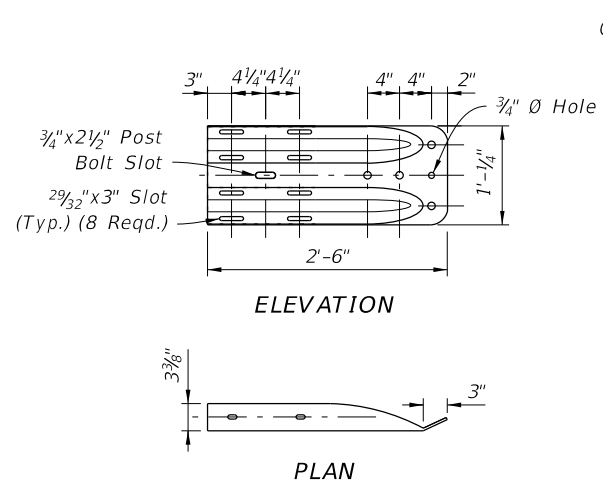
INSTALLED SECTION

POST MOUNT CAP



INSTALLED PLAN

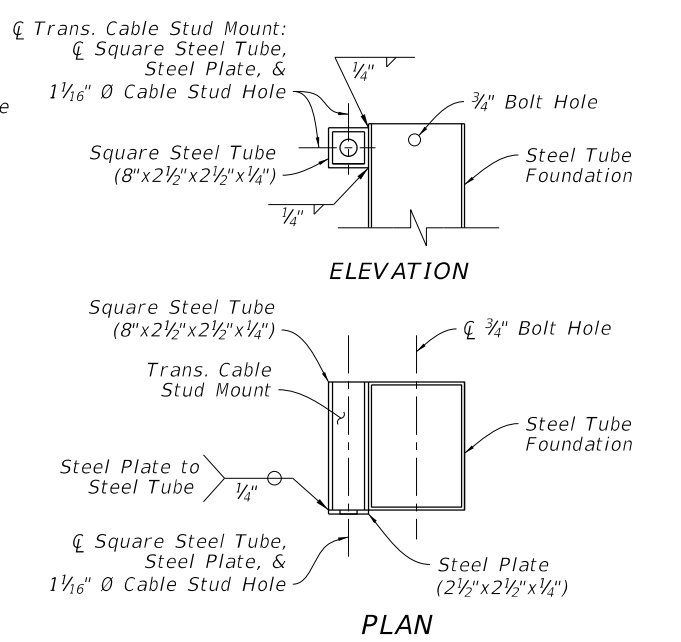
CRT END TREATMENT ASSEMBLY



ELEVATION

PLAN

SPECIAL END SHOE



ELEVATION

PLAN

TRANSVERSE CABLE STUD MOUNT

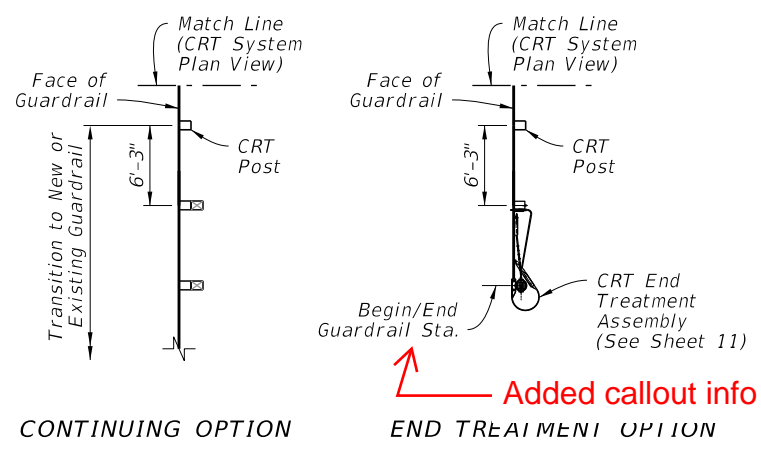
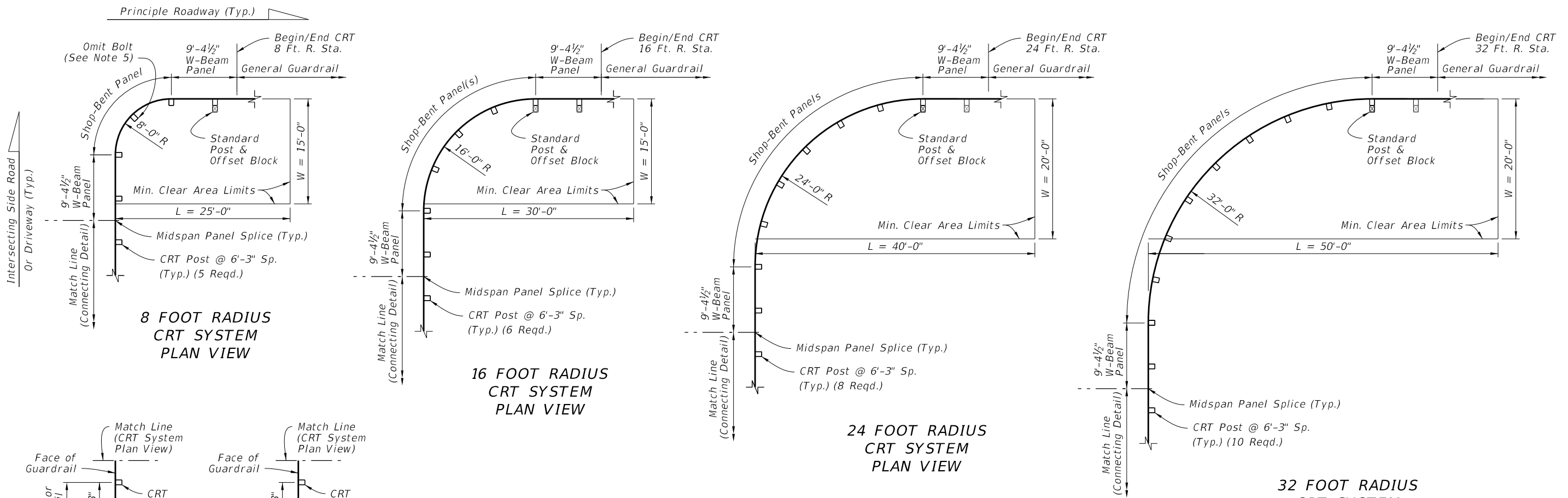
NOTES:

1. INSTALLATION: Use with CRT Systems as required on Sheet 12.
2. COMPONENT DETAILS: For additional component details, See Sheet 10 & 12. For the Rectangular Washer detail, see Sheet 22.
3. MATERIALS: Use steel End Shoes, Plates, Tubes, and pipes in accordance with Specifications 967.
4. PARTIAL CABLE ASSEMBLY: The Partial Cable Assembly is similar to the Cable Assembly defined on Sheet 10, except with a 9'-0" total length and the Swage Fitting and Cable Stud omitted from one end.
Feed the Cable Stud through the Cable Stud Hole of the Transverse Cable Stud Mount as shown, and secure it with the Hex Jam Nut System as defined on Sheet 10.
5. SPECIAL END SHOE MOUNT: Punch a 3/4" diameter hole in the W-Beam Panel as needed to secure the Special End Shoe with the 3/8" diameter Hex-Head Bolt. Galvanize hole per Specification 562.
6. FOUNDATIONS: Install Steel Tubes with attached Soil Plates by either of the following methods:
 - a. Excavate, backfill, and compact material to provide full passive soil resistance to all surfaces of the tube and soil plate.
 - b. Drive the steel tube and soil plate as a single unit using a dummy timber post to prevent damage to the breakaway post.
7. END DELINEATOR: Mount retroreflective sheeting to the approach face of the Buffer End Unit in accordance with Specifications 536 and 967.

END TREATMENT - CONTROLLED RELEASE TERMINAL (CRT) SYSTEM

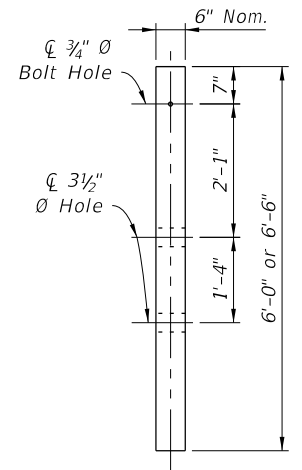
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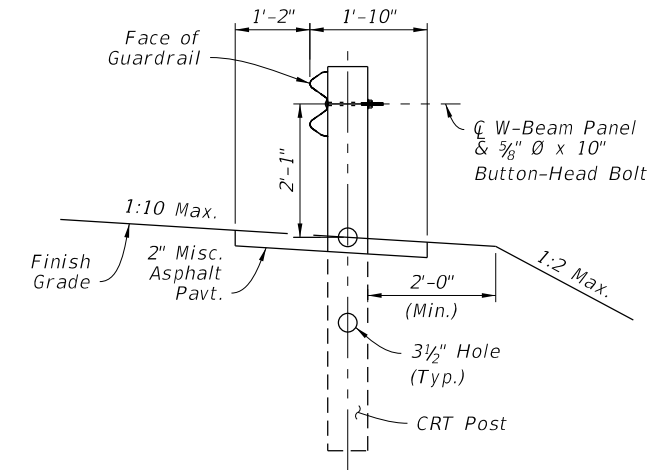


CRT SYSTEM SUMMARY TABLE:

RETURN RADIUS (FT.)	LENGTH OF SHOP-BENT PANEL(S) (FT.)	QUANTITY OF CRT POSTS	AREA CLEAR OF HAZARDS 'L' x 'W' (FT.)
8	12.5	5	25 x 15
16	25.0	6	30 x 15
24	37.5	8	40 x 20
32	50.0	10	50 x 20



CRT POST ELEVATION (6"x8" Nom. Timber)



CRT INSTALLED SECTION

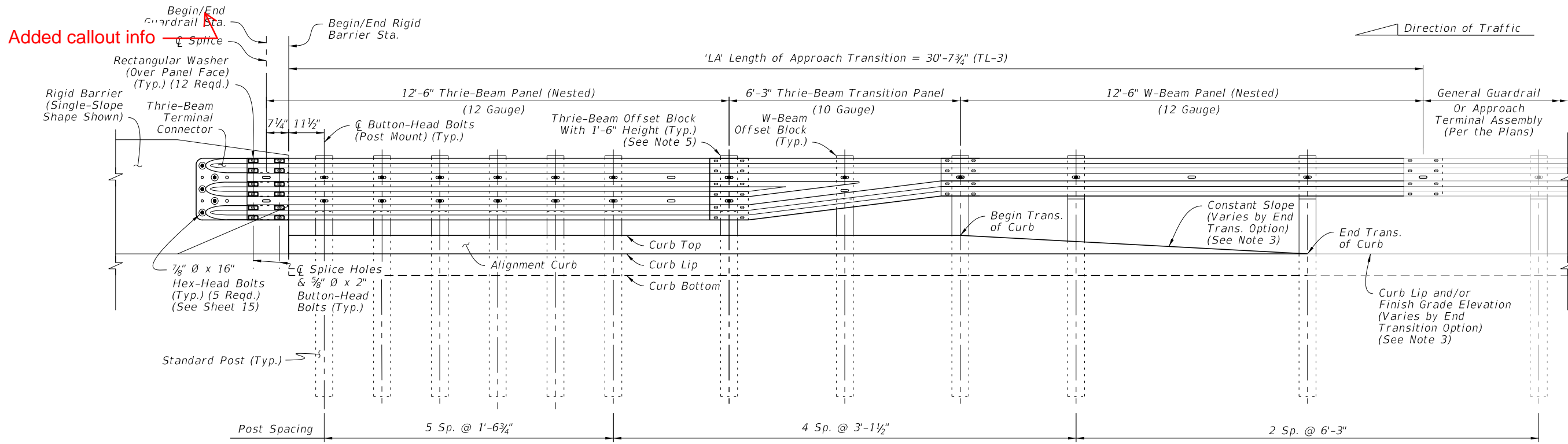
NOTES:

1. INSTALLATION: Construct the specified radius layout and Connecting Detail option as shown in the plans.
2. MIN. CLEAR AREA: Keep the area behind the CRT free of fixed objects and aboveground hazards within the Min. Clear Area limits shown. Maintain a slope not steeper than 1:10 for a minimum 2' behind the posts, and maintain a slope not steeper than 1:2 beyond 2' from the posts.
3. APPROACH GRADING: Maintain grading on the roadway side of the guardrail face at a maximum slope of 1:10.
4. MATERIALS: For CRT Posts, use Timber Post material in accordance with Specification 967. Use steel panels and hardware in accordance with Specification 967.
5. BOLT OMISSION: For the 8 Foot Radius CRT System only, do not place a panel-to-post mount bolt at the center CRT Post (omit the 5/8" Button-Head Bolt only at the location shown).
6. SHOP-BENT PANELS: Install Shop-Bent panel(s) where indicated using 12'-0" or 25'-0" W-Beam Panels. Splice at post locations within the CRT radius using the General configuration of 5/8" Ø Button-Head Bolts (8 reqd. per splice).
7. GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Approach Transitions, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.

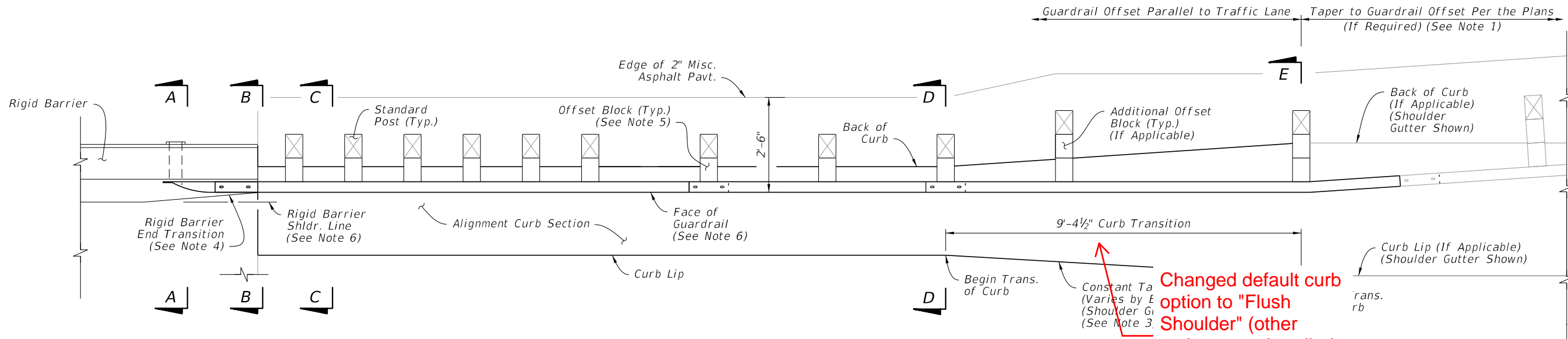
LAYOUT FOR CONTROLLED RELEASE TERMINAL (CRT) SYSTEMS - SIDE ROADS AND DRIVEWAYS

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TL-3 APPROACH TRANSITION
INSTALLED ELEVATION



TL-3 APPROACH TRANSITION
INSTALLED PLAN

Changed default curb option to "Flush Shoulder" (other options now handled on new following sheet)

NOTES:

- INSTALLATION: Construct the Approach Transition segment where plans. The required offset of the connecting adjacent guardrail plans. The Layouts given on Sheet 17 provide basic schemes for connections to adjacent guardrail, where a taper to a differing guardrail offset may be required. If the adjacent guardrail segment has the transition segment, then no taper is required. For existing bridge connection options, see Sheet 15, 14, and 521-405.
- SECTION VIEWS & DETAILS: For cross sections and details including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 15.
- TRANSITION OF CURB OPTION: The Plan and Elevation views depict an example Transition to Shoulder Gutter from Section D-D to E-E, but this transition may require a different shape depending on the End Transition option indicated in the plans (Either a 'Shoulder Gutter Option', 'Raised Curb Option', or 'Flat No Curb Option'). See Sheet 15 for curb shape details.
- RIGID BARRIER END TRANSITION: Taper the Rigid Barrier toe as shown. See Concrete Barrier, Index 521-001, and Traffic Railing, Indexes 521-422 and 521-428, for details.
- OFFSET BLOCKS: For Thrie-Beam post locations within the Length of Approach Transition segment, use the Timber Offset Blocks with 1'-6" height shown on Sheet 5. For the midspan of the Thrie-Beam Transition Panel and for all other W-Beam locations shown herein, use the W-Beam Offset Blocks with 1'-2" height.
- OFFSET: The required offset difference between the Face of Guardrail and Rigid Barrier Shoulder Line is considered negligible and may not be shown in the guardrail offset callouts in the plans. A consistent guardrail offset deviation of up to 4 inches outside of the Rigid Barrier Shoulder Line is permitted over the length 'LA'.
- GENERAL GUARDRAIL: General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Approach Terminals, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.

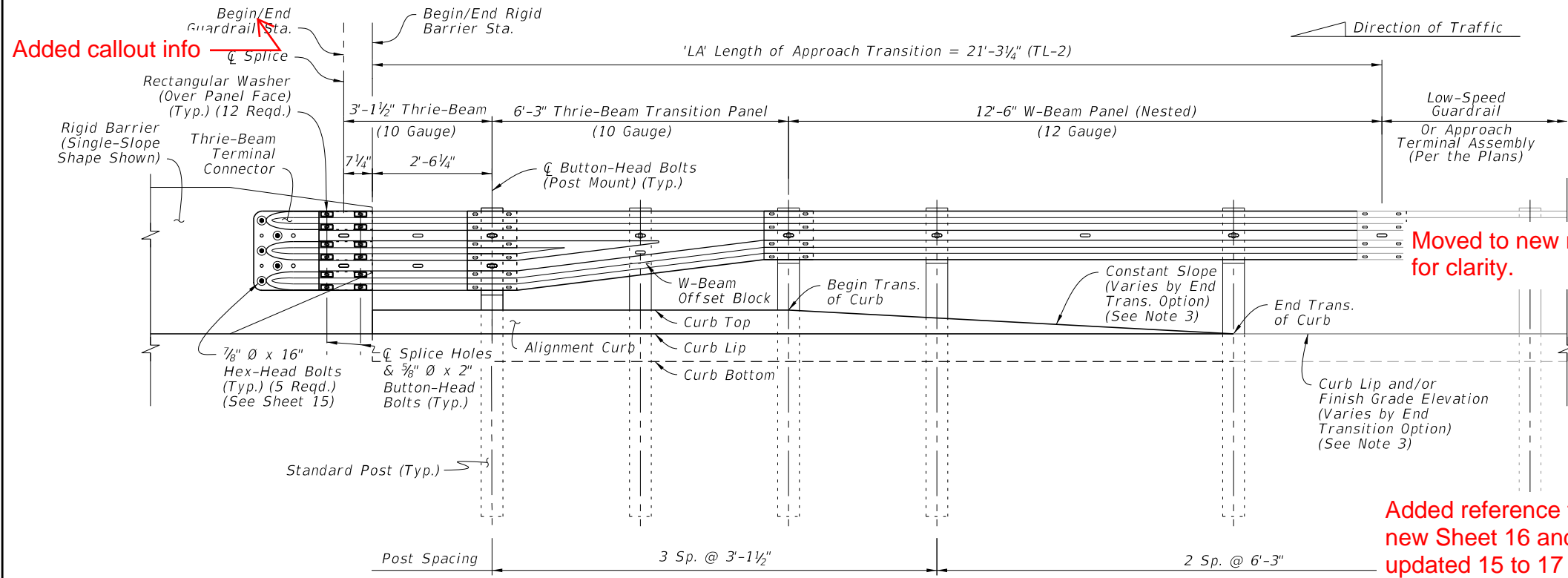
Added reference to new Sheet 14 and updated 15 to 17

Moved to new note 3 for clarity.

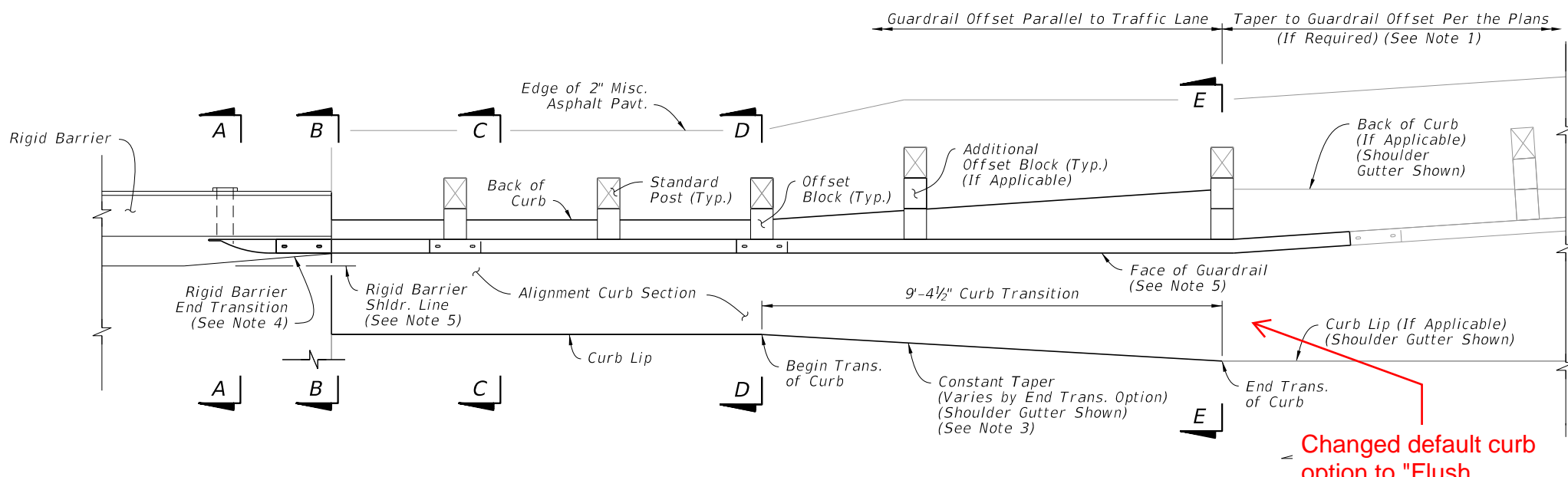
Updated to Sheet 17

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TL-2 APPROACH TRANSITION
INSTALLED ELEVATION



TL-2 APPROACH TRANSITION
INSTALLED PLAN

NOTES:

1. INSTALLATION: Construct the Approach Transition segment where indicated in the plans. The required offset of the connecting adjacent guardrail is shown in the plans.

The Layouts given on Sheet 17 provide basic schemes for connections to adjacent guardrail, where a taper to a differing guardrail offset may be required. If the adjacent guardrail segment has the same offset as the Approach Transition segment, then no taper is required.

For existing bridge connection options, see Indexes 536-002, 521-404, and 521-405.
2. SECTION VIEWS & DETAILS: For cross sections and details including the barrier mounting hardware, curb transition, adjacent guardrail, see Sheet 15. Updated to Sheet 17
3. END TRANSITION OF CURB OPTION: The Plan and Elevation views depict an example Curb Transition to Shoulder Gutter from Section D-D to E-E, but this transition may require a different shape depending on the End Transition option indicated in the plans (Either a 'Shoulder Gutter Option', 'Raised Curb Option', or 'Flat No Curb Option'). See Sheet 15 for curb shape details.
4. RIGID BARRIER END TRANSITION: Taper the Rigid Barrier toe as shown. See Concrete Barrier, Index 521-001, and Traffic Railing, Indexes 521-422 thru 521-428, for details.
5. OFFSET: The required offset difference between the Face of Guardrail and Rigid Barrier Shoulder Line is considered negligible and may not be shown in the guardrail offset callouts in the plans. A consistent guardrail offset deviation of up to 4 inches outside of the Rigid Barrier Shoulder Line is permitted over the length 'LA'.
6. LOW-SPEED GUARDRAIL: Low-Speed Guardrail typically includes Panels and Post Spacing as shown on Sheet 3, including parallel and tapered segments. Approach Terminals, General Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the Low-Speed Guardrail shown herein if indicated in the plans.

APPROACH TRANSITION CONNECTION
TO RIGID BARRIER - LOW-SPEED, TL-2

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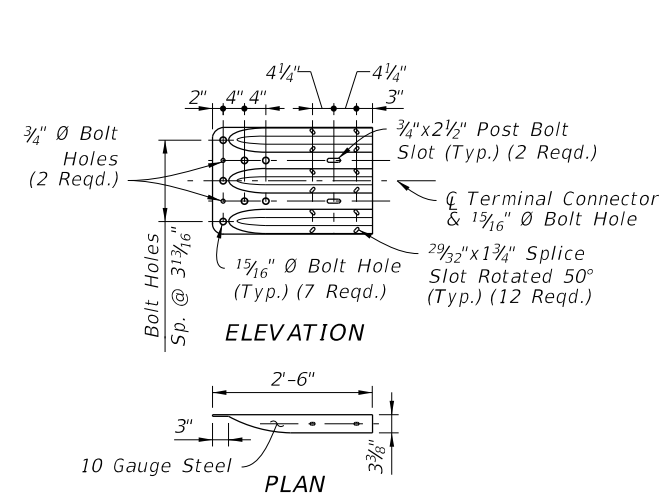
FDOT
FY 2019-20
STANDARD PLANS

GUARDRAIL

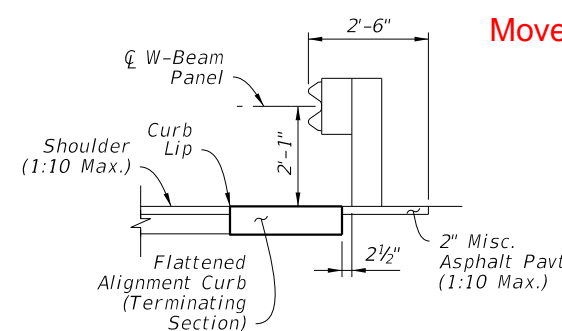
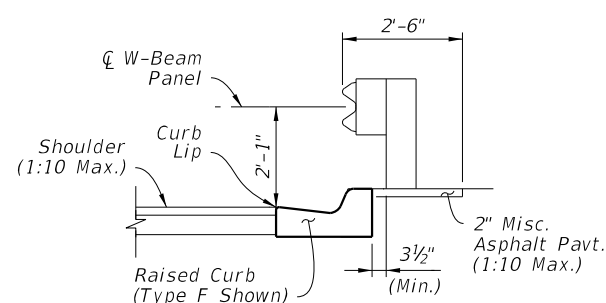
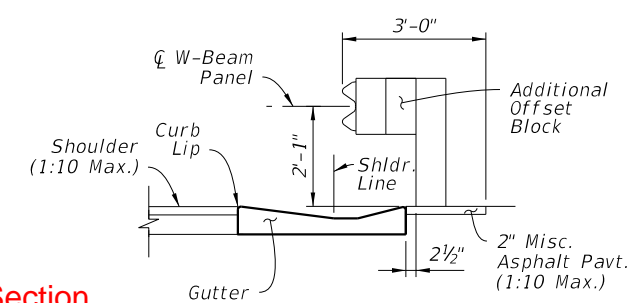
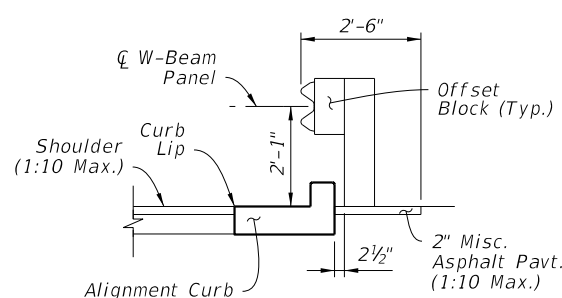
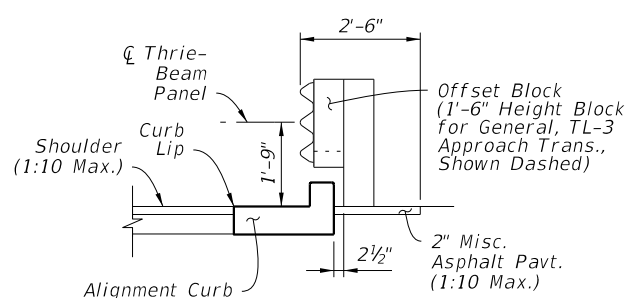
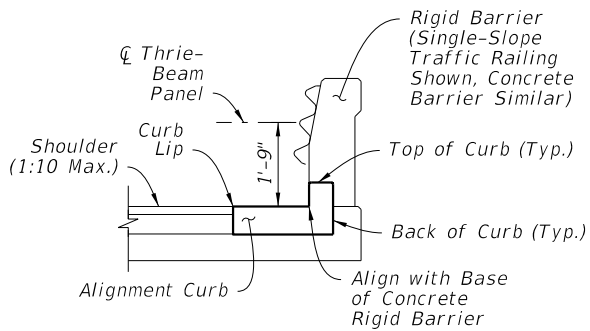
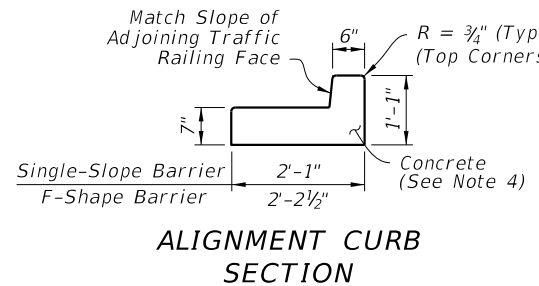
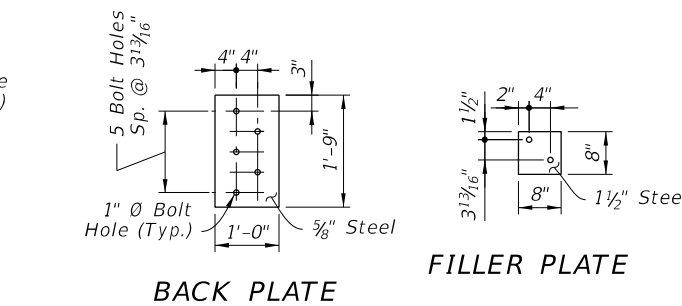
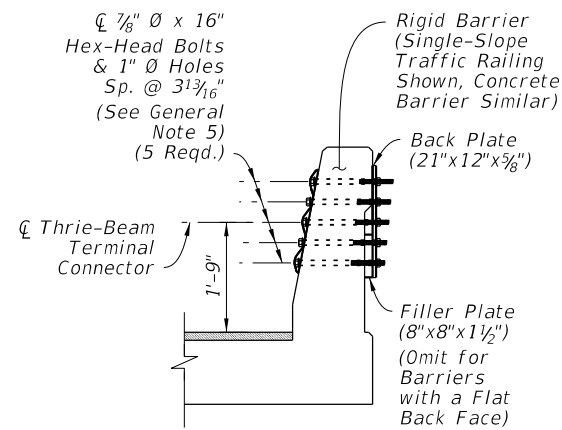
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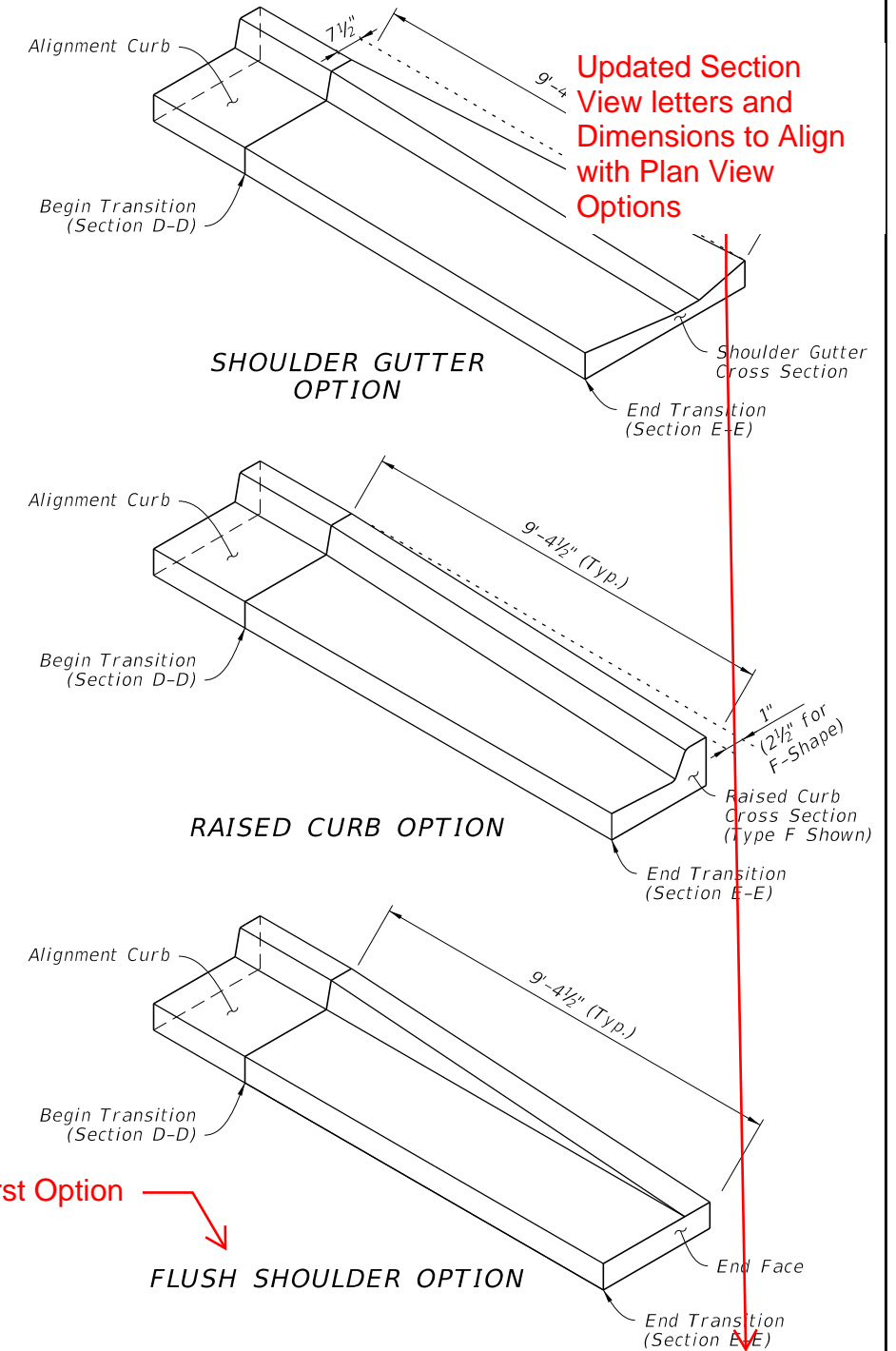
24



THRIE-BEAM TERMINAL CONNECTOR DETAIL



CURB TYPICAL SECTIONS



CURB TRANSITION ISOMETRIC VIEWS

NOTES:

1. PLAN AND ELEVATION VIEWS: Work with Sheets 13 & 14.
2. END TRANSITION OF CURB OPTION: Install one of the three End Transition types shown per Section E-E as indicated by the plans.
3. GRADING BEHIND POSTS: Place Slope Break a Min. 2'-0" behind the post, per Sheet 6.
4. MATERIALS & CONSTRUCTION: Construct the concrete Aligning Curb and Curb transition in accordance with Specification 520. Use steel Plates and Thrie-Beam Terminal Connectors in accordance with Specification 967.

APPROACH TRANSITION CONNECTION - DETAILS

Updated Section View letters and Dimensions to Align with Plan View Options

Moved to First Option

11-0
2/13/2019

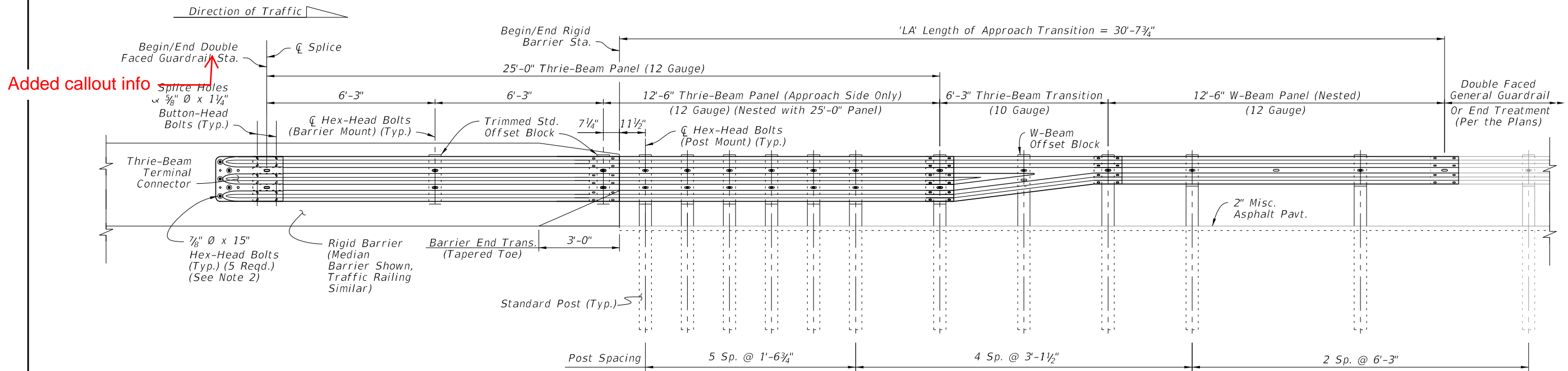
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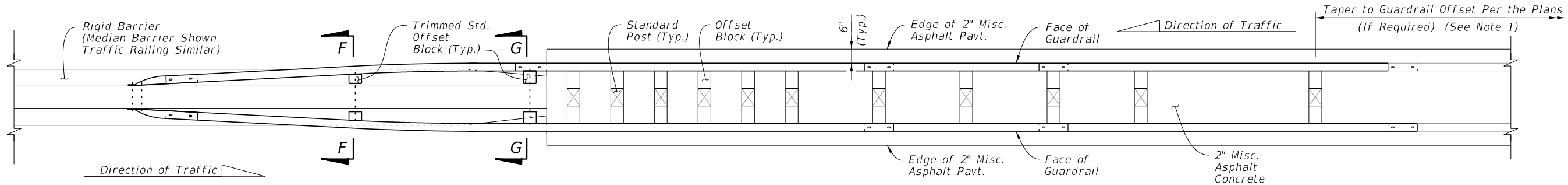
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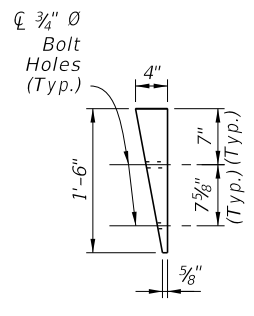


TL-3 DOUBLE FACED APPROACH TRANSITION
INSTALLED ELEVATION

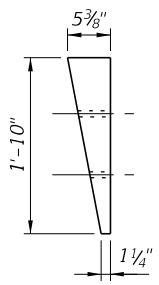


TL-3 DOUBLE FACED APPROACH TRANSITION
INSTALLED PLAN

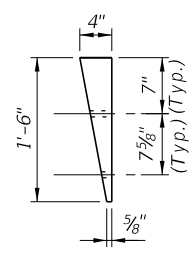
- NOTES:**
- INSTALLATION:** Construct the Approach Transition segment where indicated in the plans. The required offset of the connecting adjacent guardrail is shown in the plans.
The Layouts given on Sheet 18 provide basic schemes for connections to adjacent guardrail, where a taper to a differing guardrail offset may be required. If the adjacent guardrail has the same offset as the Approach Transition segment, then no taper is required.
 - THRIE-BEAM TERMINAL CONNECTOR:** See Sheet 15 for Details. The installed bolt's threaded portion is not permitted to extend beyond 3/4" from the face of the nut; trim the threaded portion as needed and galvanize in accordance with Specification 562.
 - GENERAL GUARDRAIL:** General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. End Treatments or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.



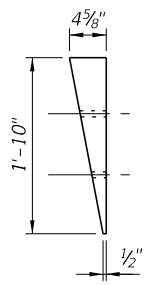
TYPE F-F SECTION



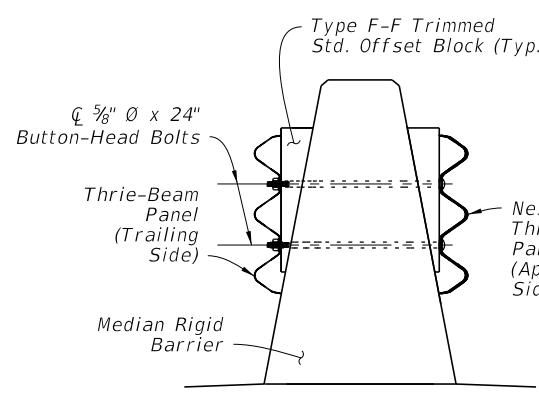
TYPE G-G SECTION



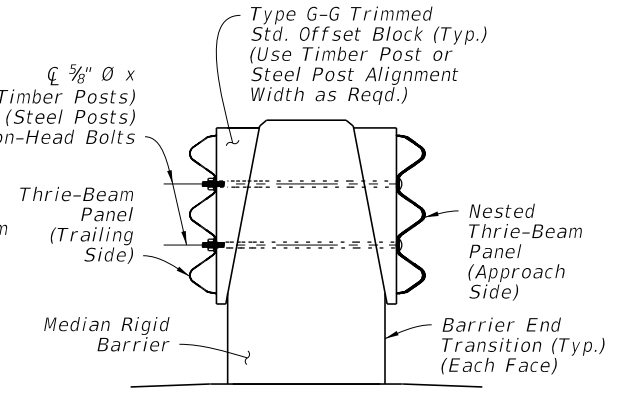
TYPE F-F SECTION



TYPE G-G SECTION



SECTION F-F



SECTION G-G

==== TRIMMED STD. OFFSET BLOCKS ==== TRIMMED STD. OFFSET BLOCKS
TIMBER POST ALIGNMENT WIDTH STEEL POST ALIGNMENT WIDTH

APPROACH TRANSITION CONNECTION TO
RIGID BARRIER WITH DOUBLE FACED GUARDRAIL

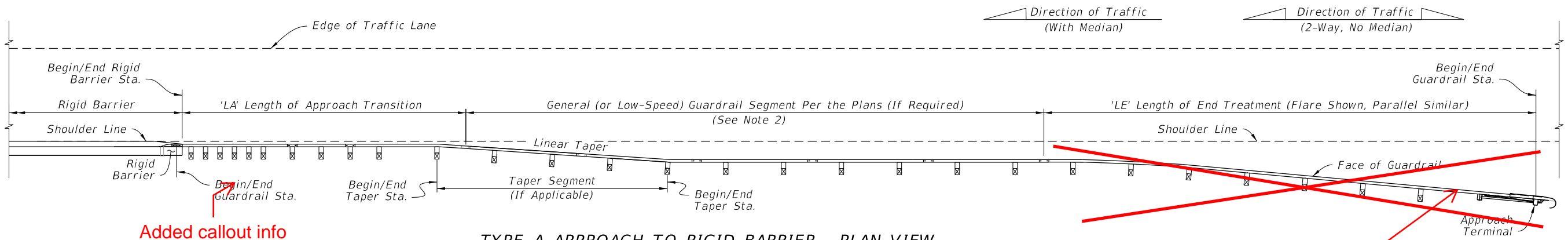
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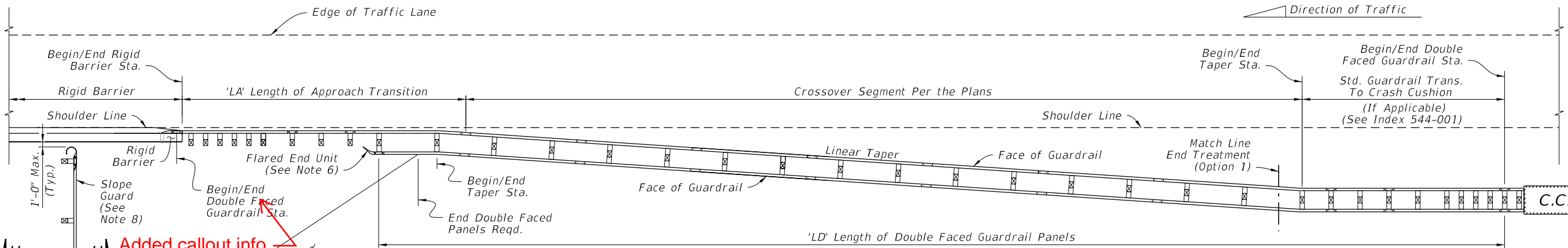
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Added callout info

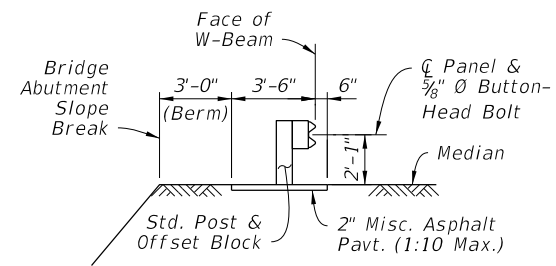
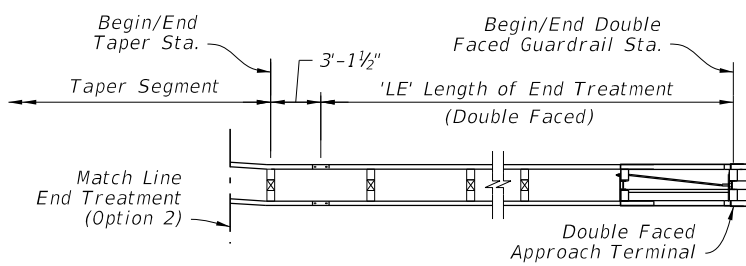
TYPE A APPROACH TO RIGID BARRIER - PLAN VIEW
MEDIAN OR OUTSIDE SHOULDERS
 (Mirror Horiz. and/or Vert. for Opposite Direction and/or Side of Road)

Replaced with parallel terminal



Added callout info

TYPE B APPROACH TO RIGID BARRIER - PLAN VIEW
CROSSOVER GUARDRAIL FOR MEDIAN SHOULDERS ONLY
DUAL BRIDGE APPROACH CONFIGURATION
 (Mirror Horiz. and Vert. for Opposite Direction)



SECTION H-H
BRIDGE ABUTMENT
SLOPE GUARD
(Between Bridges)

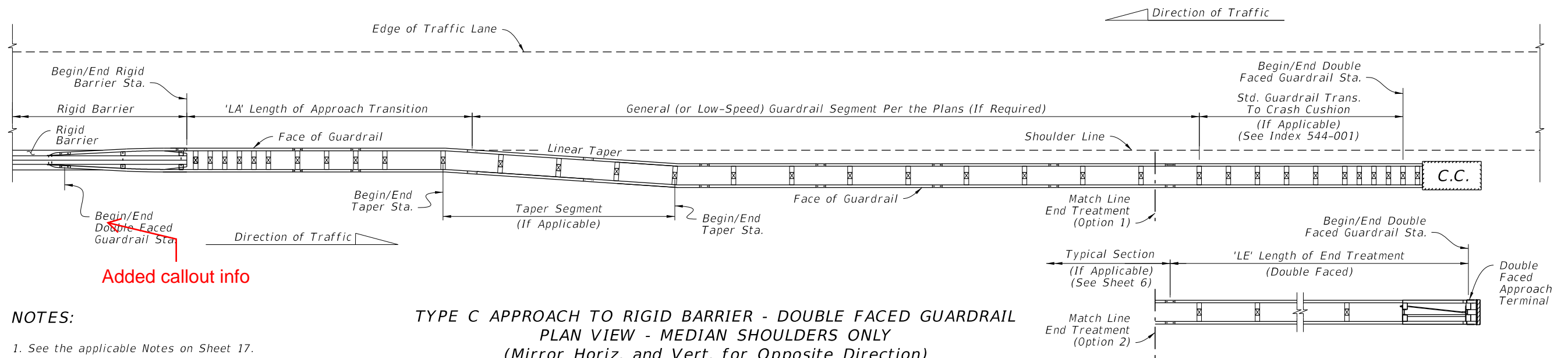
NOTES:

- INSTALLATION:** The Plan Views shown are schematic only, showing example geometry for connecting guardrail segments including taper locations and Double Faced Guardrail requirements as applicable. Work this Sheet with the plans, where stationing and offsets for Begin/End Guardrail, Begin/End Rigid Barrier, and Begin/End Taper are specified. For existing bridge layouts, see Index 536-002, 521-404, and 521-405.
- GENERAL (OR LOW-SPEED) GUARDRAIL SEGMENT:** Construct this segment if shown in the plans. For the case where this segment's offset differs from the Approach Transition offset, linearly taper the guardrail between the Begin/End Taper Stations and offsets as specified in the plans.
 For the shortest length case of a direct connection between the End Treatment and the Approach Transition, this segment may be omitted as shown in the plans.
- LENGTH OF APPROACH TRANSITION 'LA':** Install the Approach Transition as shown per Sheet 13 or 14 as called for in the plans.
- LENGTH OF END TREATMENT 'LE':** Install the Approach Terminal End Treatment as shown per Sheet 7 or 8, where called for in the plans. Use the corresponding APL drawings for construction details.
- CROSSOVER GUARDRAIL (FOR TYPE B APPROACH):** Install the Crossover Segment tapering linearly from the Begin Taper Sta. and offset to the End Taper Sta. and offset as specified in the plans.
- LENGTH OF DOUBLE FACED GUARDRAIL PANELS, 'LD' (FOR TYPE B APPROACH):** Terminate the Double Faced Guardrail panels as shown (based upon the 30° line measured from the hazard on the opposite side of the median). Extend the panel segment longer than the dimension 'LD' as needed for the Panel's end Bolt Slot to align with a post Bolt hole.
 Install a Flared End Unit where shown, as defined on Sheet 9.
- END TREATMENT OPTIONS (FOR TYPE B & C APPROACH):** For Double Faced applications, use either a Double Faced Approach Terminal Assembly per Sheet 8 or a Crash Cushion per Index 544-001. For either Option, meet the 1:10 adjacent grading requirements for Approach Terminals as shown on Sheet 8.
- SLOPE GUARD:** Where indicated in the plans, install a Guardrail segment between bridge approaches and offset from the bridge abutment's Slope Break as shown. Install posts at the end bolt slots of the panel system. Use post spacing of either 3'-1 1/2" or 6'-3", as needed to correctly fit system between barriers. The system may also be lengthened to fit by installing two Rounded End Units as defined on Sheet 9.

LAYOUT TO RIGID BARRIER -
APPROACH ENDS

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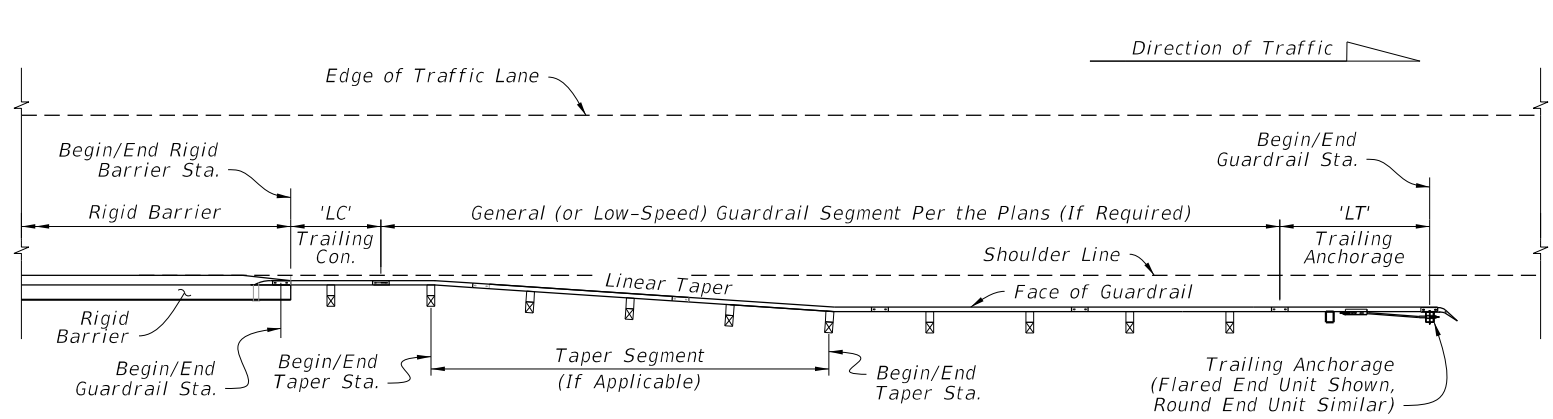
LAST REVISION 11/01/18	DESCRIPTION: 11/01/19	FDOT FY 2019-20 STANDARD PLANS	GUARDRAIL	INDEX 536-001	19 SHEET 17 of 22	24
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NOTES:
1. See the applicable Notes on Sheet 17.

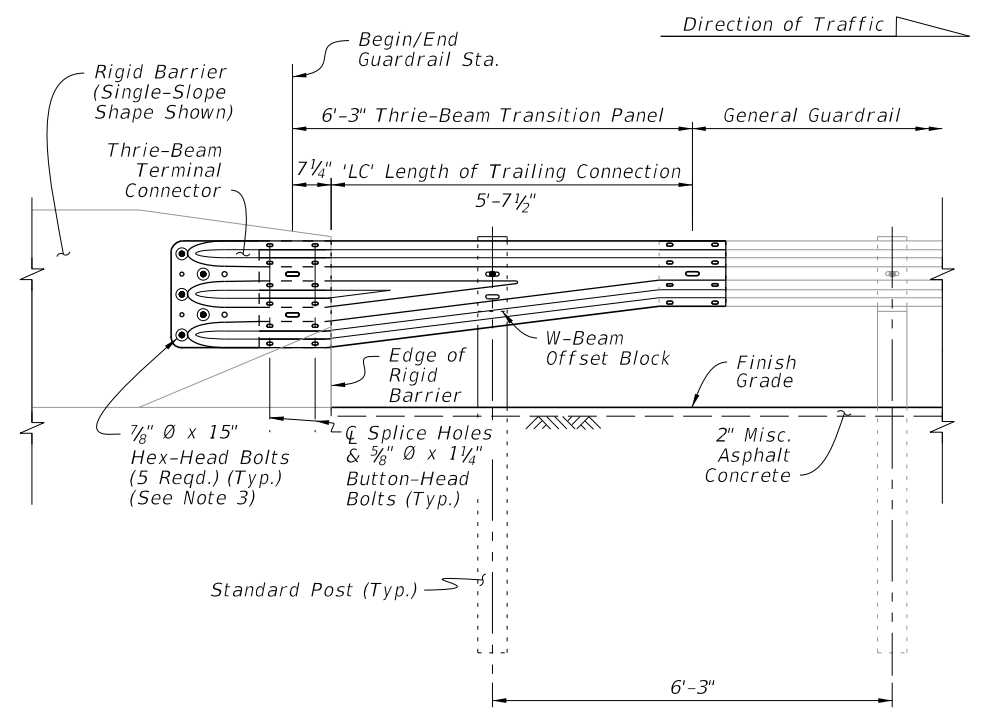
**TYPE C APPROACH TO RIGID BARRIER - DOUBLE FACED GUARDRAIL
PLAN VIEW - MEDIAN SHOULDERS ONLY
(Mirror Horiz. and Vert. for Opposite Direction)**

**LAYOUT TO RIGID BARRIER -
APPROACH ENDS WITH
DOUBLE FACED GUARDRAIL**



**TYPE D TRAILING CONNECTION FROM RIGID BARRIER
PLAN VIEW - MEDIAN OR OUTSIDE SHOULDER
(Mirror Horiz. and/or Vert. for Opposite
Direction and/or Side of Road)**

NOTES:
1. See the applicable Notes on Sheet 17.
2. LENGTH OF TRAILING ANCHORAGE, 'LT': Install the Trailing Anchorage as shown on Sheet 9, where called for in the plans.
3. THRIE-BEAM TERMINAL CONNECTOR: Install connector and bolts as shown on Sheet 15.
4. RIGID BARRIER SINGLE SLOPE END FACE: See Concrete Barrier Wall, Index 521-001, and Traffic Railing, Indexes 521-422 and 521-423, for details.



**TRAILING END TRANSITION CONNECTION
TO RIGID BARRIER - INSTALLED ELEVATION**

**LAYOUT TO RIGID BARRIER -
TRAILING ENDS**

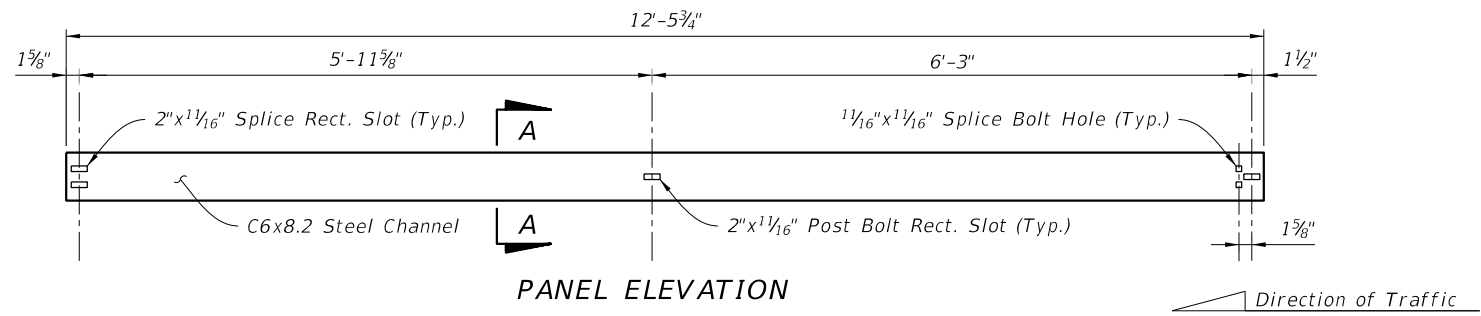
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11/01/19	11/01/19

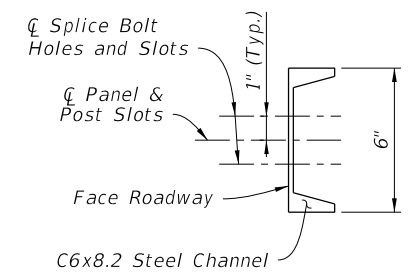

**FY 2019-20
STANDARD PLANS**

GUARDRAIL

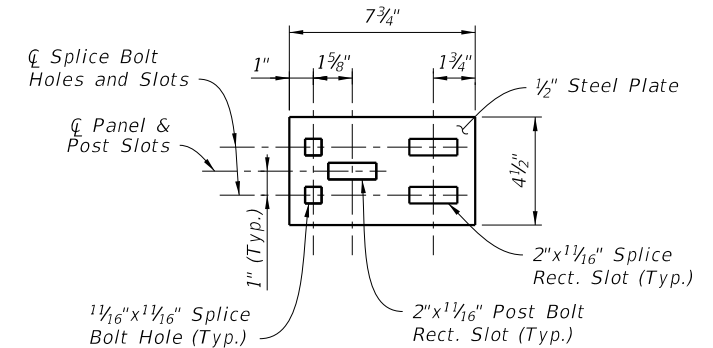
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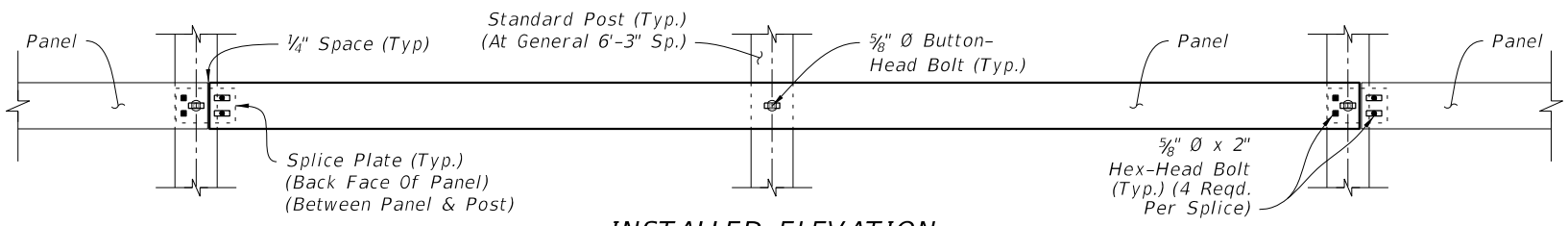
PANEL ELEVATION



SECTION A-A
(Panel Typical)

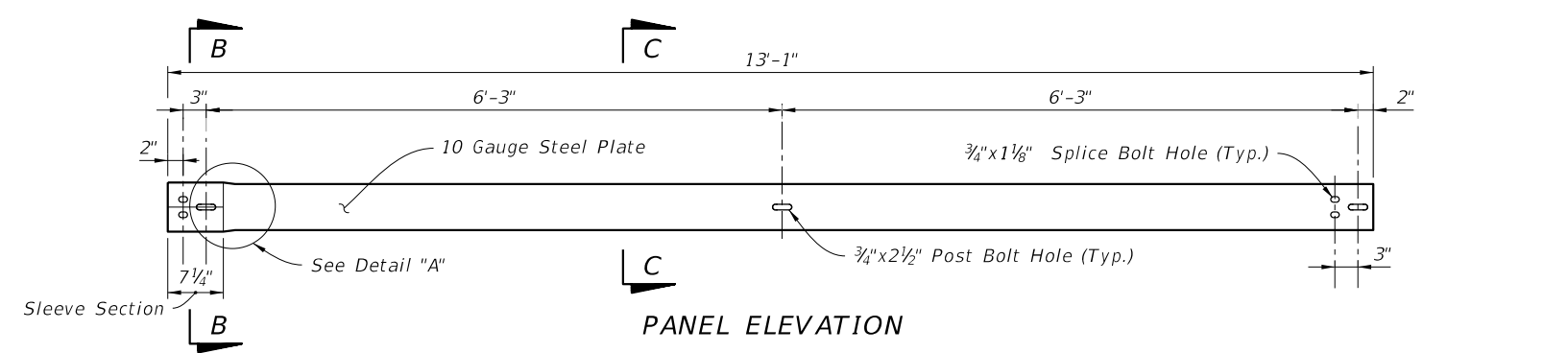


SPLICE PLATE ELEVATION

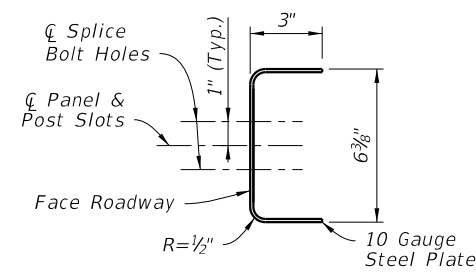


INSTALLED ELEVATION

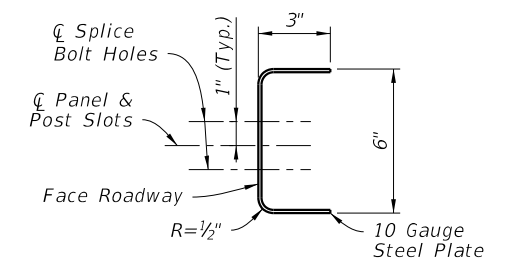
CHANNEL SECTION RUB RAIL



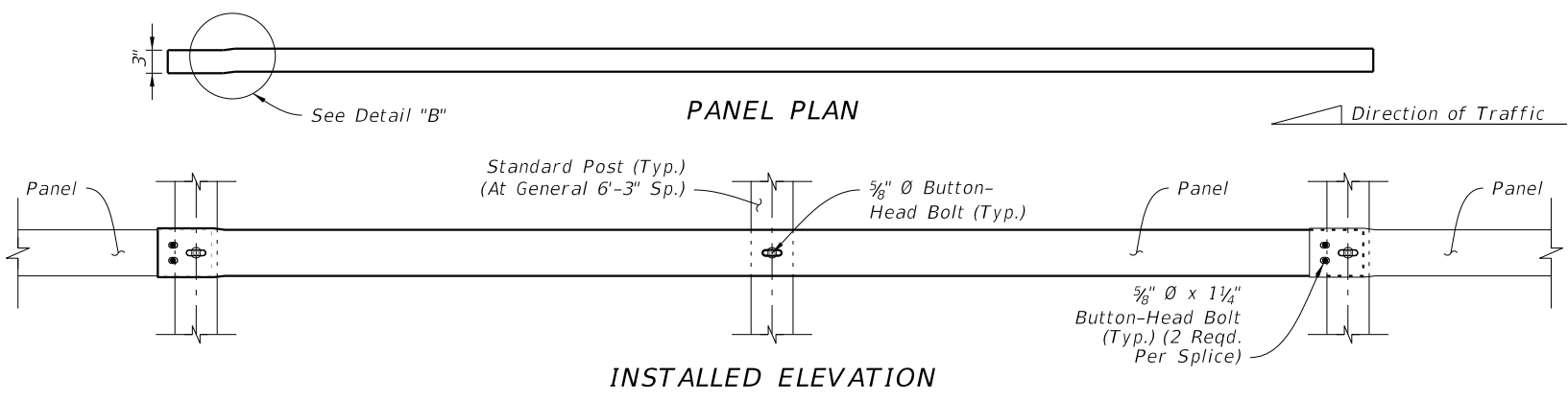
PANEL ELEVATION



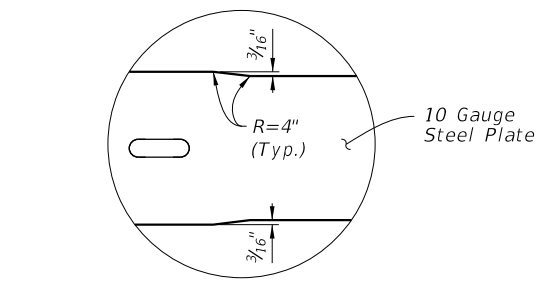
SECTION B-B
(Panel Sleeve End)



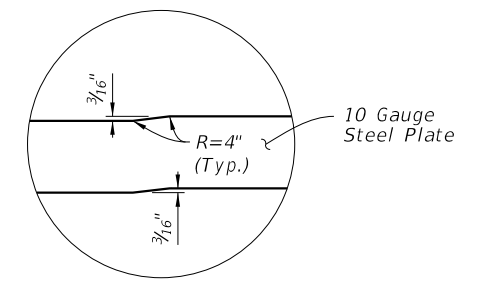
SECTION C-C
(Panel Typical)



INSTALLED ELEVATION



DETAIL "A"
(Sleeve Transition Elevation)



DETAIL "B"
(Sleeve Transition Plan)

BENT-PLATE PANEL RUB RAIL



RUB RAIL TERMINATION - SCHEMATIC PLAN VIEW

NOTES:

Updated to parallel approach terminal

1. all Rub Rail where called for in the plans. Position as shown on Sheet 6 unless otherwise shown in the the backs of Rub Rail panels flush against Standard Posts. Either of the Channel Section or Bent-Plate options may be used (consistent type per project). Where Double Sided Rub Rail is called for, thread the bolt through the Post Bolt Hole(s) and the panels on either side, and tighten the nut against the face of the panel farthest from adjacent traffic lanes. Trim the bolt's threaded portion in accordance with Note 4 on Sheet 5.

- 2. MOUNTING HEIGHT: Mount to the Standard Post's Rub Rail Bolt Hole as defined on Sheet 5.
- 3. MATERIALS: Use steel components in accordance with Specification 967.
- 4. END RUB RAIL: For Single Sided Rub Rail, terminate the run of Rub Rail by bending the panel behind the post and securing in place (as shown). For Double Sided Rub Rail, terminate the runs of Rub Rail on their respective front face of the post and secure with the typical Button-Head bolt.

RUB RAIL DETAILS

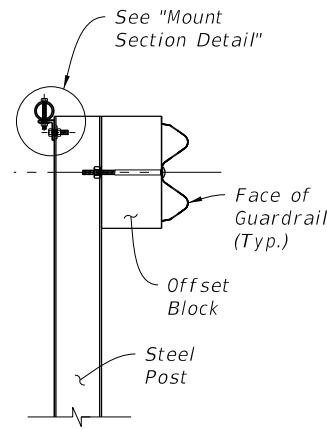
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11/01/19	11/01/19

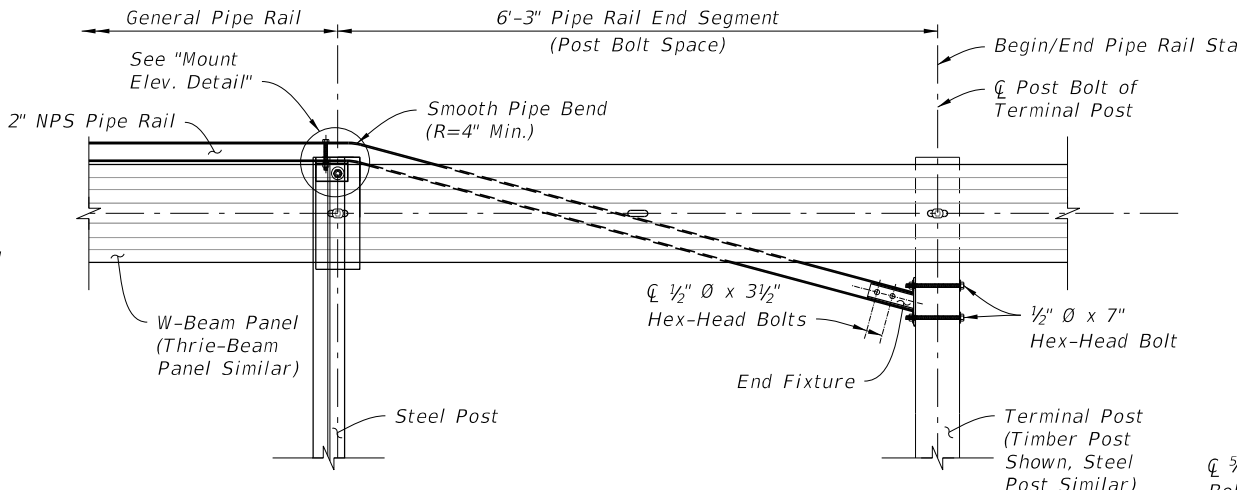
FY 2019-20
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GUARDRAIL

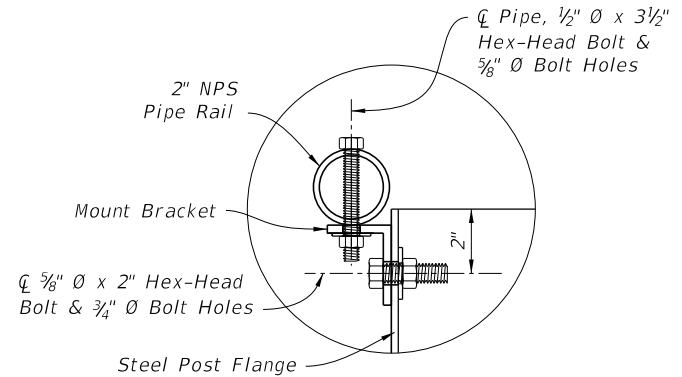
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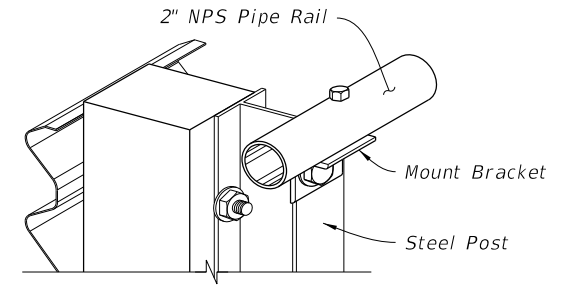
GENERAL PIPE RAIL SECTION



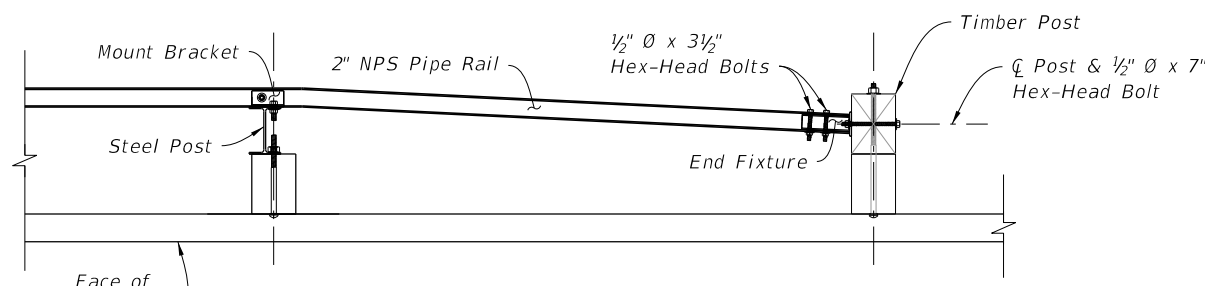
PIPE RAIL INSTALLED ELEVATION (End Segment Shown)



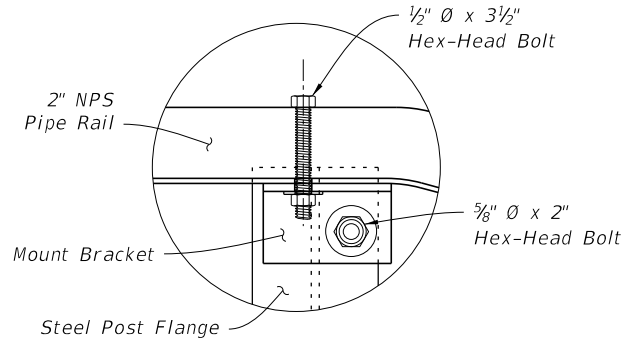
MOUNT SECTION DETAIL



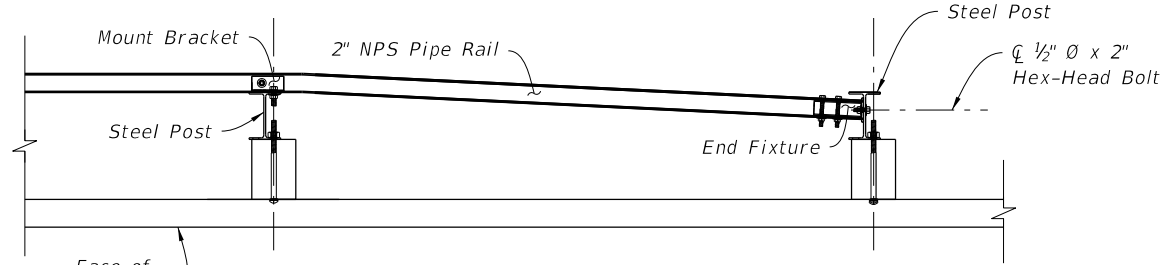
MOUNT ISOMETRIC CUT-AWAY



PIPE RAIL INSTALLED PLAN END AT TIMBER POST OPTION

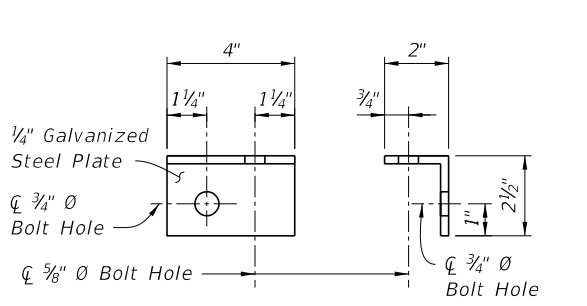


MOUNT ELEVATION DETAIL (Back View - Mirrored)

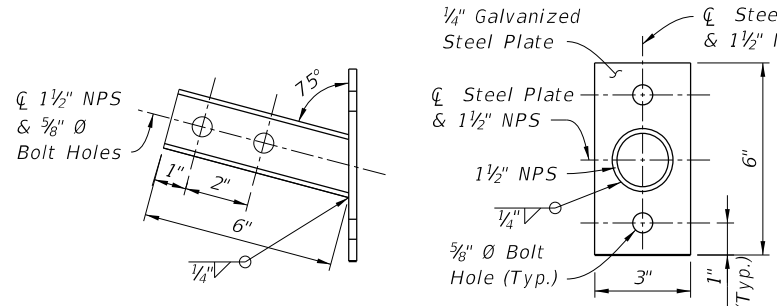


PIPE RAIL INSTALLED PLAN END AT STEEL POST OPTION

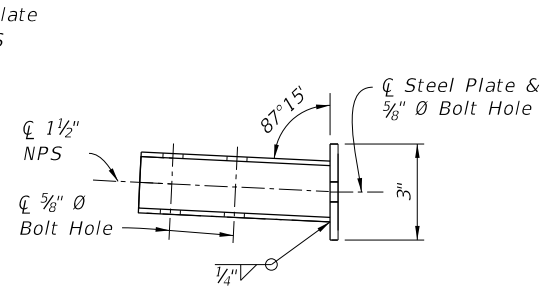
- NOTES:**
1. GENERAL: Install General Pipe Rail where indicated in the plans or when existing sidewalks or shared use paths are located less than 4'-0" from the back of Steel Posts as shown on Sheet 6.
 2. PIPE RAIL END SEGMENTS: Place End Segments on both ends of General Pipe Rail runs, with End Fixtures mounted to Terminal Posts located outside of Approach Terminal Assembly ('LE'), Trailing Anchorage Assembly ('LT'), and Approach Transition ('LA') segments.
 3. MATERIALS: Use steel brackets, fixtures, and pipes in accordance with Specification 967.
 4. RAIL SPLICES: Install Rail Splices to join pieces of 2" NPS Pipe Rail into a continuous system. Place splices as needed, at a spacing of 18'-0" or greater. Orient the head of bolt on the top of the pipe.



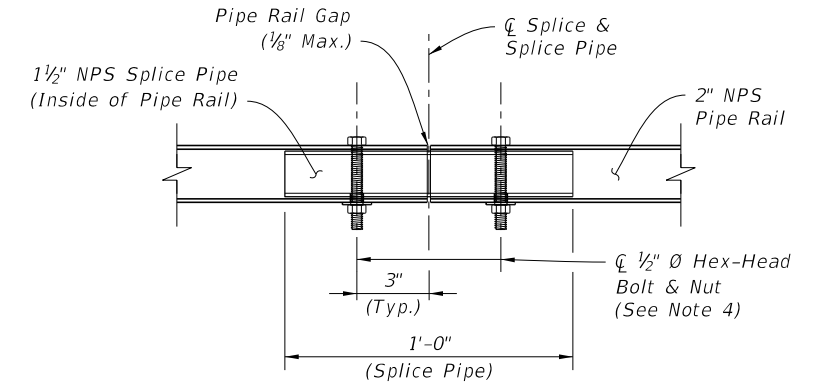
ELEVATION SECTION



ELEVATION SECTION



PLAN



RAIL SPLICE DETAIL

PEDESTRIAN SAFETY TREATMENT - PIPE RAIL

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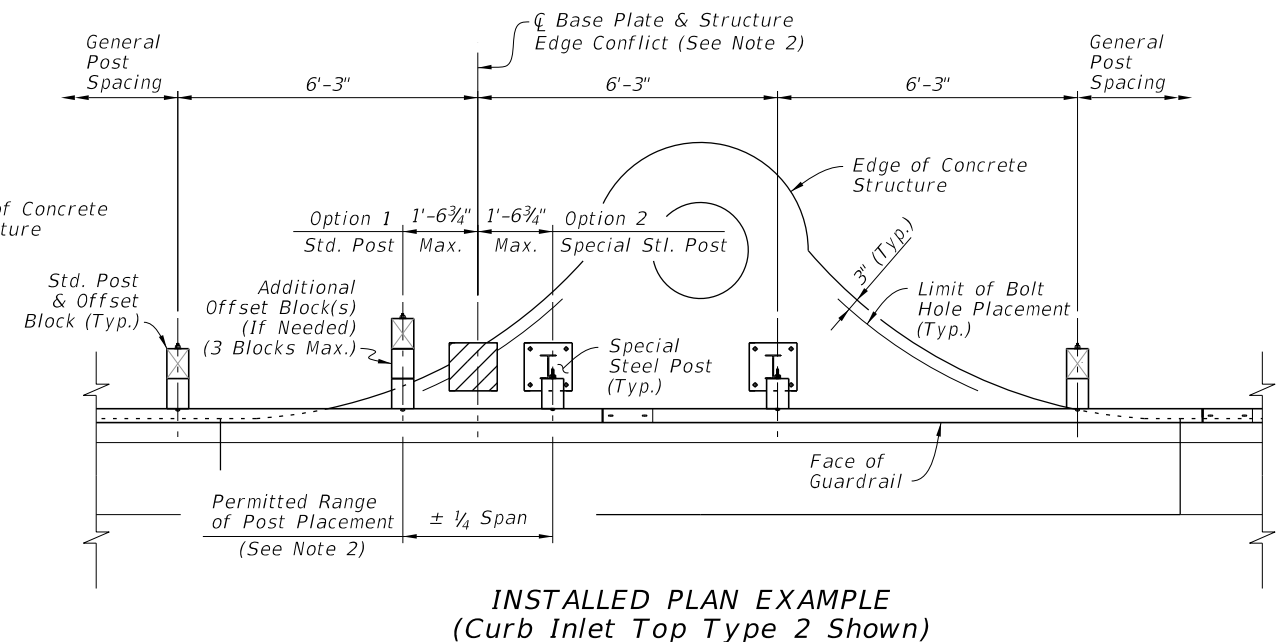
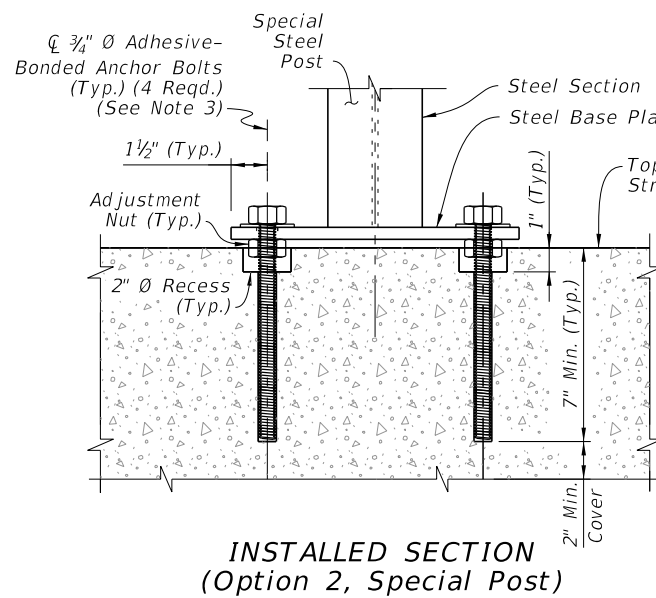
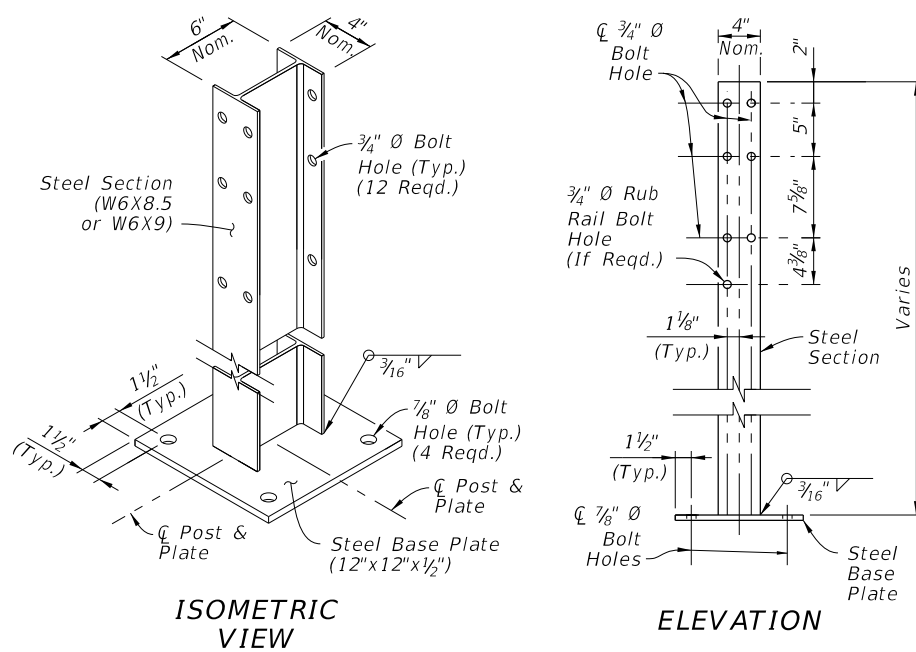
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GUARDRAIL

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SPECIAL STEEL POST

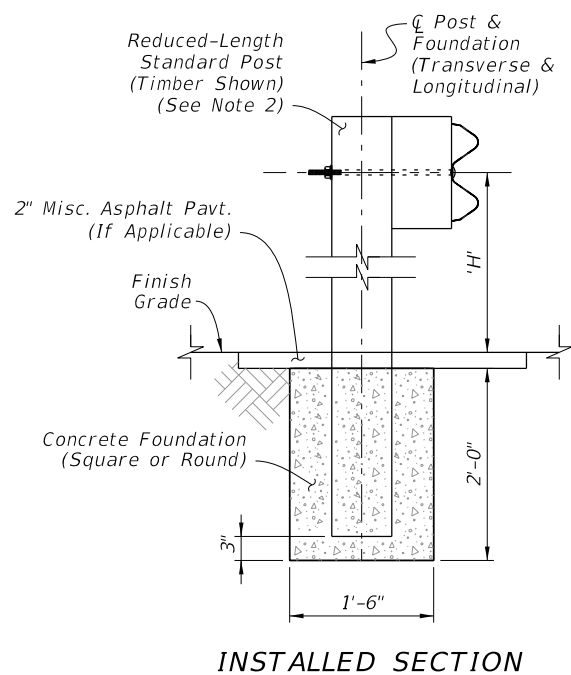
STRUCTURE MOUNTING

NOTES:

- INSTALLATION:** When the construction of Guardrail at the required post spacing results in post(s) located atop culverts, inlets, pier footings, or similar concrete structures, a Special Steel Post may be substituted for a Standard Post. Install where shown in the plans and/or as-needed, in accordance with Specification 536.
- EDGE CONFLICT:** When a required post location causes an Edge Conflict with the structure, where the Steel Base Plate is not located entirely on the structure at least 3" from the Edge of Concrete, the longitudinal post location may be altered by up to 1'-6 3/4" (Quarter Span) from the original required spacing location to prevent the Edge Conflict. With the post location adjusted, use a Std. Post mounted in soil (Option 1) or a Special Steel Post with its Base Plate mounted entirely on the structure (Option 2). Maintain the original required spacing locations upstream and downstream of the structure.

- BASE PLATE MOUNT:** Install Special Steel Posts as shown using steel Adhesive-Bonded Anchor Bolts in accordance with Specifications 536. Use 3/4" Hex-Head Bolts for structures less than 9" deep as defined in the Specification.
- PANEL MOUNT TO ADJUSTED POST:** Punch additional 3/4"x2 1/2" Post Bolt Slot(s) in the W-Beam or Thrie-Beam Panel only where needed to mount the panel to a post in an adjusted location. Meet the Panel Post Bolt Slots requirements of Specification 536.
- MATERIALS:** Use steel base plates in accordance with Specification 536.

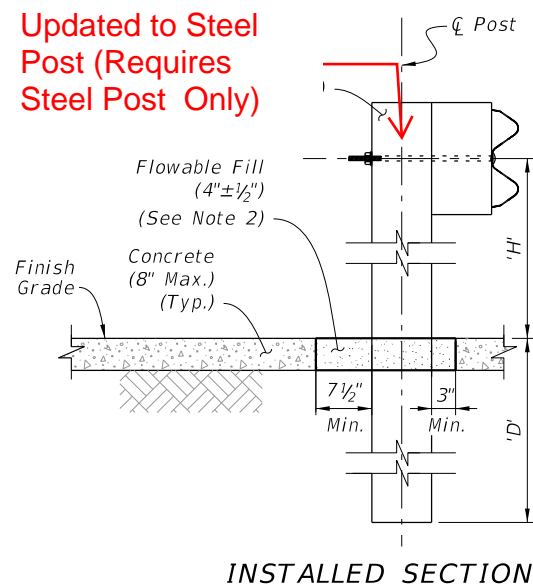
SPECIAL STEEL POST FOR CONCRETE STRUCTURE MOUNT



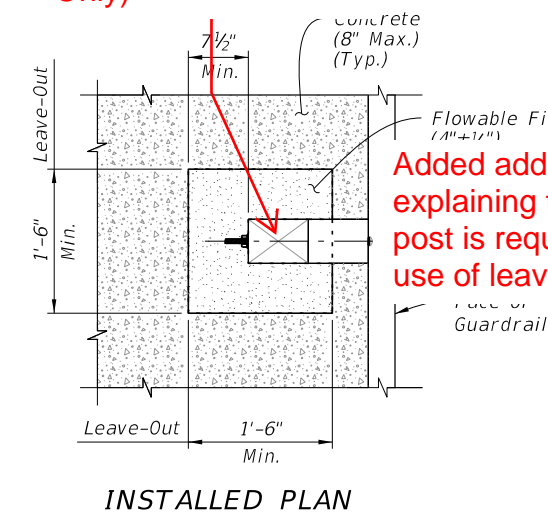
NOTES:

- INSTALLATION:** When the construction of Guardrail at the required post spacing results in post(s) conflicting with underground utilities or other underground obstructions, an Encased Post may be used where a 2'-0" depth will avoid the conflict. Install where shown in the plans and/or as-needed, in accordance with Specification 536.
- REDUCED-LENGTH STANDARD POST:** Use a Standard Post with reduced Length such that the Panel Height 'H' is maintained while the post bottom terminates 3" from the bottom of the Concrete Foundation. Typically, the Post Length 'L' is 4'-7" for W-Beam Guardrail.
- FOUNDATION:** Use non-reinforced Class NS Concrete material in accordance with Specification 347. After casting the concrete, ensure the surrounding soil material is completely backfilled and tamped to provide full passive resistance.
- LIMIT:** Encased Posts are not permitted for consecutive posts unless otherwise shown in the plans.

ENCASED POST FOR SHALLOW MOUNT



Updated to Steel Post (Requires Steel Post Only)



NOTES:

- INSTALLATION:** When the construction of Guardrail at the required post spacing results in post(s) placed within a concrete surface (typically a sidewalk), use a Frangible Leave-Out around the post base as shown. Install where shown in the plans and/or as-needed, in accordance with Specification 536.
 Added additional note explaining that a steel post is required with use of leave-out
- MATERIALS:** Use Non-Excavatable Flowable Fill in accordance with Specification 121, not to exceed 150 psi.

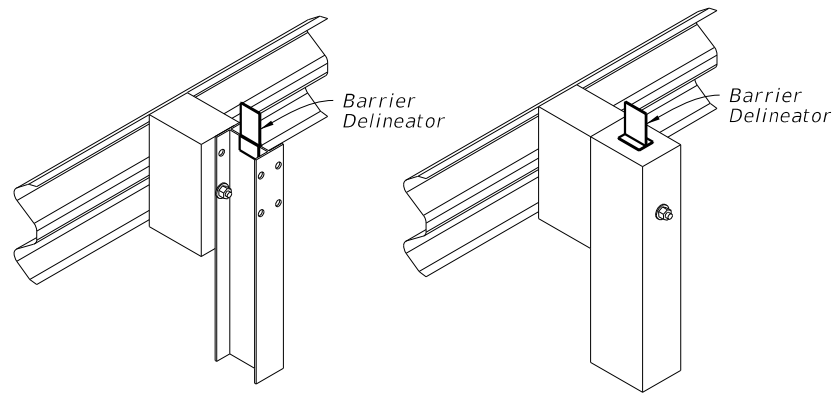
FRANGIBLE LEAVE-OUT FOR CONCRETE SURFACE MOUNT

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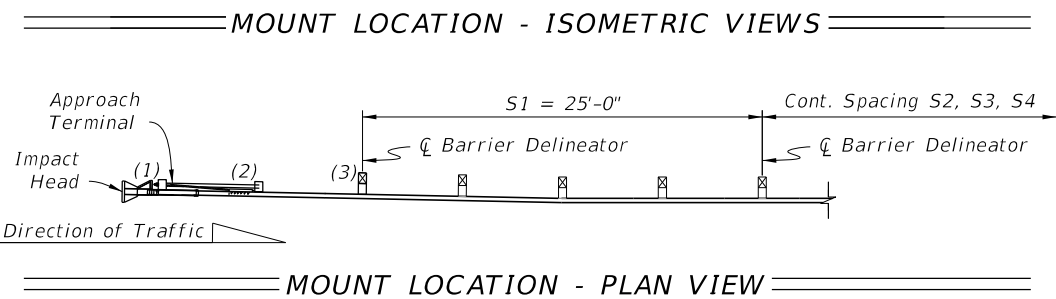
LAST REVISION	DESCRIPTION:
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NOTES:

- INSTALLATION:** Install Barrier Delineators as shown in accordance with the plans, with Specifications 536 and 705, and with the manufacturer's design as approved on the APL.
- MATERIALS:** Use materials of the size and type defined for Barrier Delineators in Specifications 993.
- COLOR:** Use either white or yellow retroreflective sheeting to match the color of the nearest lane's edgeline.
- MOUNT LOCATIONS:** Mount Barrier Delineators atop posts as shown, starting with Post (3) of Approach Terminals and incrementally increasing spacing towards the downstream direction. Install the Barrier Delineators at the following spacing:
 S1 = 25' x 1 Space
 S2 = 50' x 1 Space
 S3 = 75' x 1 Space
 S4 = 100' x for the Remaining Run
 Additionally, place a Barrier Delineator on Post (2) of the Trailing Anchorage or on the post nearest the Rigid Barrier.
- MEDIAN GUARDRAIL:** Install retroreflective sheeting on both sides of the barrier delineator for Guardrail on medians.



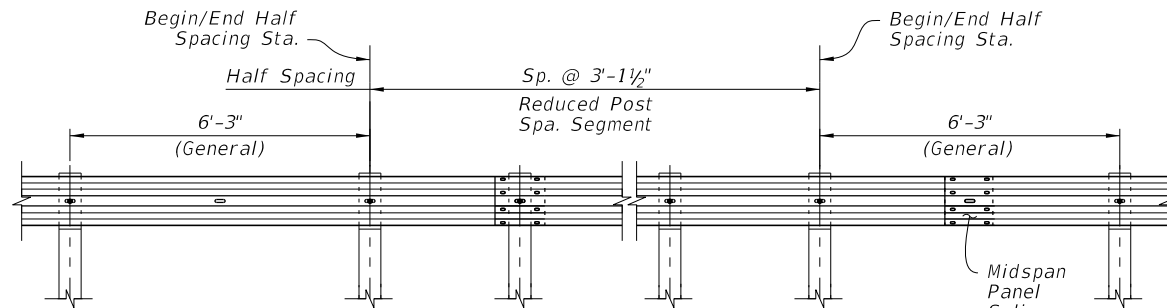
STEEL POSTS TIMBER POSTS



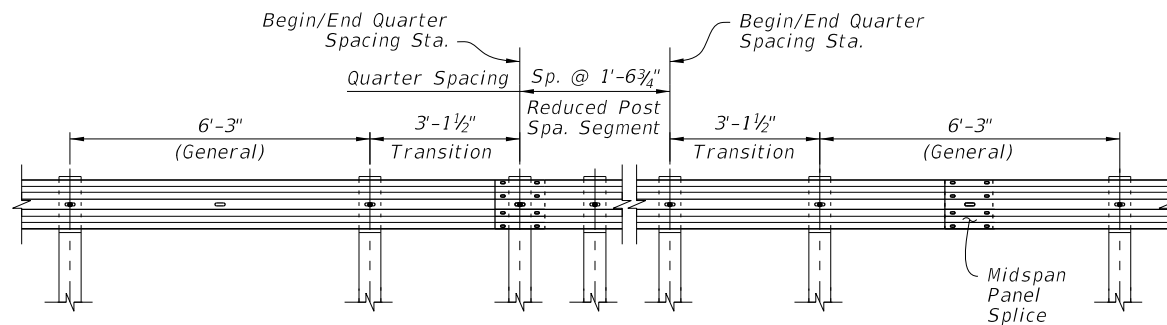
BARRIER DELINEATORS

NOTES:

- INSTALLATION:** Work these details with the plans, where Stationing for Begin/End Half Spacing and Begin/End Quarter Spacing are indicated if required.
 Where the Begin/End Stations indicated in the plans do not correspond exactly to post locations in construction, extend the Reduced Post Spacing segment to the nearest post(s) before the Begin Station and/or after the End Station called for.
- PANEL SPLICES:** Midspan Panel Splices are not required in Transition and Reduced Post Spacing segments, however they are required for General segments. To place midspan splices in General segments, use one Non-General panel length (9'-4½" or 15'-7½") or add an additional Transition spaced post where required.
- LOW-SPEED GUARDRAIL:** For Reduced Post Spacing with Low-Speed Guardrail (12'-6" post spacing), the Reduced Spacing pattern requires a 6'-3" space between the 12'-6" and 3'-1½" spaces.
- PANEL POST BOLT SLOTS:** For Quarter Spacing configurations, punch additional ¾"x2½" Post Bolt Slots in the panels only where required for mounting and in accordance with Specification 536.

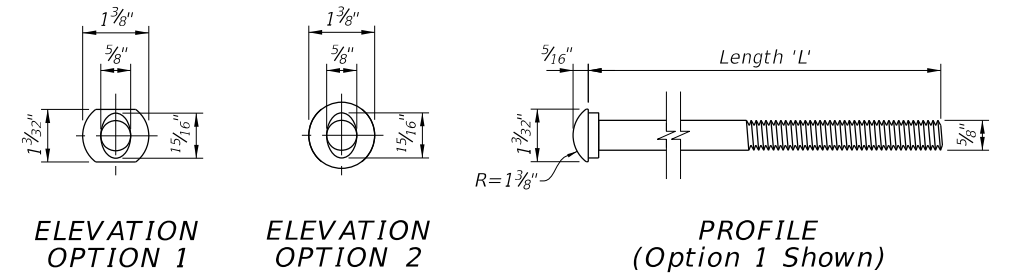


DETAIL 'S' - HALF SPACING ELEVATION (AS REQD. PER THE PLANS)

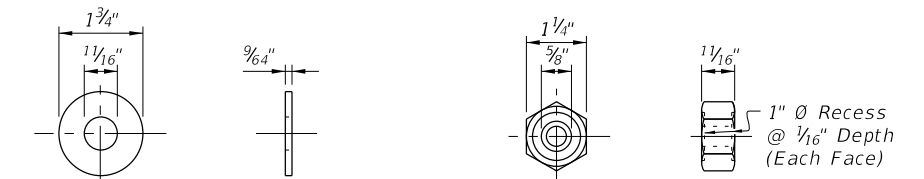


DETAIL 'S' - QUARTER SPACING ELEVATION (AS REQD. PER THE PLANS)

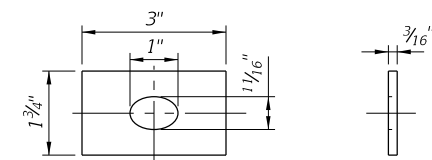
REDUCED POST SPACING FOR HAZARDS



BUTTON-HEAD BOLT



WASHER HEX-NUT



RECTANGULAR WASHER (For CRT & Terminal Connectors Where Shown - Install Over Panel Face)

BUTTON-HEAD BOLT LENGTHS:

Application(s):	Length 'L':	Min. Thread Length:
Panel Splice	1 1/4"	Full Length
Steel Post Mount - Single Faced Guardrail	10"	4"
Timber Post Mount - Single Faced Guardrail	18"	4"
Steel or Timber Post Mount - Double Faced Guardrail	25"	4"
Modified Thrie Beam Panel / Terminal Connector Splice	2"	Full Length

NOTES:

- Use nuts, bolts, and washers in accordance with Specification 967.
- For Steel Posts with Double Faced Guardrail, the single 25" Length bolt (one bolt thru both post flanges) may be replaced with two 10" Length bolts (one bolt per post flange).
- Use bolts listed in Table 2 in corresponding locations shown in this Index.

5/8" BUTTON-HEAD BOLT SYSTEM

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2	General, TL-3 Guardrail - Installed Plan and Elevation
3	Low-Speed, TL-2 Guardrail - Installed Plan and Elevation
4	W-Beam and Thrie-Beam Panel Details
5	Post and Offset Block Details
6	Guardrail Sections - Heights and Adjacent Slopes
7	End Treatment - Approach Terminal Geometry, Parallel
8	End Treatment - Approach Terminal Geometry, Curbed and Double Faced
9	End Treatment - Trailing Anchorage
10	End Treatment - Component Details
11	End Treatment - Controlled Release Terminal (CRT) System
12	Layout for CRT System - Side Roads and Driveways
13	Approach Transition Connection to Rigid Barrier - General, TL-3
14	Approach Transition Connection to Rigid Barrier - General, TL-3 - Curb Connections
15	Approach Transition Connection to Rigid Barrier - Low-Speed, TL-2
16	Approach Transition Connection to Rigid Barrier - Low-Speed, TL-2 - Curb Connections
17	Approach Transition Connection to Rigid Barrier - Details
18	Approach Transition Connection to Rigid Barrier - Double Faced Guardrail
19	Layout to Rigid Barrier - Approach Ends
20	Layout to Rigid Barrier - Approach Ends with Double Faced Guardrail Layout to Rigid Barrier - Trailing Ends Trailing End Transition Connection to Rigid Barrier
21	Rub Rail Details
22	Pedestrian Safety Treatment - Pipe Rail
23	Modified Mount - Special Steel Post for Concrete Structure Mount; Modified Mount - Encased Post for Shallow Mount; Modified Mount - Frangible Leave-Out for Concrete Surface Mount
24	Barrier Delineators - Post Mounted; Clear Space - Reduced Post Spacing for Hazards; 5/8" Button-Head Bolt System

GENERAL NOTES:

1. **INSTALLATION:** Construct guardrail in accordance with Specification 536.

This Index, along with the plans and the manufacturers' drawings on the Approved Products List (APL), is sufficiently detailed for installation of General Guardrail, Low-Speed Guardrail, End Treatment assemblies, and their connecting options shown herein. This precludes requirements for shop drawing submittals unless otherwise specified in the plans.

2. **COMPATIBILITY:** The General Guardrail in this Index is based on the Midwest Guardrail System (MGS) design, with an approximate height of 31" at the top of the Panel (2'-1" mounting height at vertical \bar{C} of Panel) and a midspan panel splice as shown on Sheet 2. Guardrail components included on the APL, which are compatible with this Index, may also be identified as 31" or MGS Guardrail.

3. **STANDARD COMPONENTS:** Standard guardrail components, including posts, panels, and bolt systems, are based upon English unit conversions of the AASHTO-AGC-ARTBA Joint Committee Task Force 13 Report: A Guide to Standardized Highway Barrier Hardware (<http://www.aashtotf13.org/Barrier-Hardware.php>).

4. **BUTTON-HEAD BOLTS:** Install Button-Head Bolts where indicated using bolts, nuts, and washers as defined on Sheet 24. Place washers under nuts. Do not place washers between bolt heads and panels, except where otherwise shown in this Index.

5. **HEX-HEAD BOLTS:** Install Hex-Head Bolts where indicated using bolts, nuts, and washers in accordance with material properties of Specification 967. Place washers under nuts.

6. **MISCELLANEOUS ASPHALT PAVEMENT:** Install Miscellaneous Asphalt Pavement where indicated with a tolerance of $\pm 1/2$ " depth and in accordance with Specification 339.

7. **ADJACENT SIDEWALKS & SHARED USE PATHS:** When guardrail posts are placed within 4'-0" of a sidewalk or shared use path, use timber posts, or use steel posts only if treated with Pipe Rail as shown on Sheet 22.

When timber posts are used, one of the following safety treatments is required for the bolt(s) protruding from the back face of the posts:

- a. After tightening the nut, trim the protruding post bolt flush with the nut and galvanize per Specification 562.
- b. Use post bolts 15" in length and countersink the washer and nut between 1" and 1 1/2" deep into the back face of the post.
- c. Use 15" post bolts with sleeve nuts and washers.

When End Treatment posts are within 4'-0" of a sidewalk or shared use path, steel posts are not permitted within the End Treatment segment. Terminate the Pipe Rail outside of End Treatment segments, as noted per Sheet 22.

8. **NESTED W-BEAM:** Where called for in the plans, install two W-Beam Panels mounted flush per location, securing all panels with Button-Head Bolts threaded through aligned slots and holes. 2" Button-Head Bolts are permitted for panel splice locations.

9. **CONNECTION TO RIGID BARRIER:** The connections to Rigid Barrier in this Index only apply to newly constructed bridge Traffic Railing and Concrete Barrier or where the complete Approach Transition Connection to Rigid Barrier shown herein can be installed without conflicting with existing Traffic Railings, structures, or approach slabs.

For connecting guardrail to existing bridge Traffic Railings, see Indexes 536-002, 521-404, and 521-405.

10. **CONNECTION TO EXISTING GUARDRAIL:** Where a transition to existing guardrail at 27" height is required, linearly transition the new guardrail height over a distance ranging from 25'-0" to 31'-3". Height transitions must occur outside of End Treatment and Approach Transition segments.


Provide an immediate transition to the required midspan panel splice using the available panel options on Sheet 4 (9'-4 1/2" or 15'-7 1/2" panel). Alternatively, this transition to midspan panel splice may be achieved by installing a single reduced post spacing of 3'- 1 1/2" within the new guardrail, immediately adjacent to the connection location.

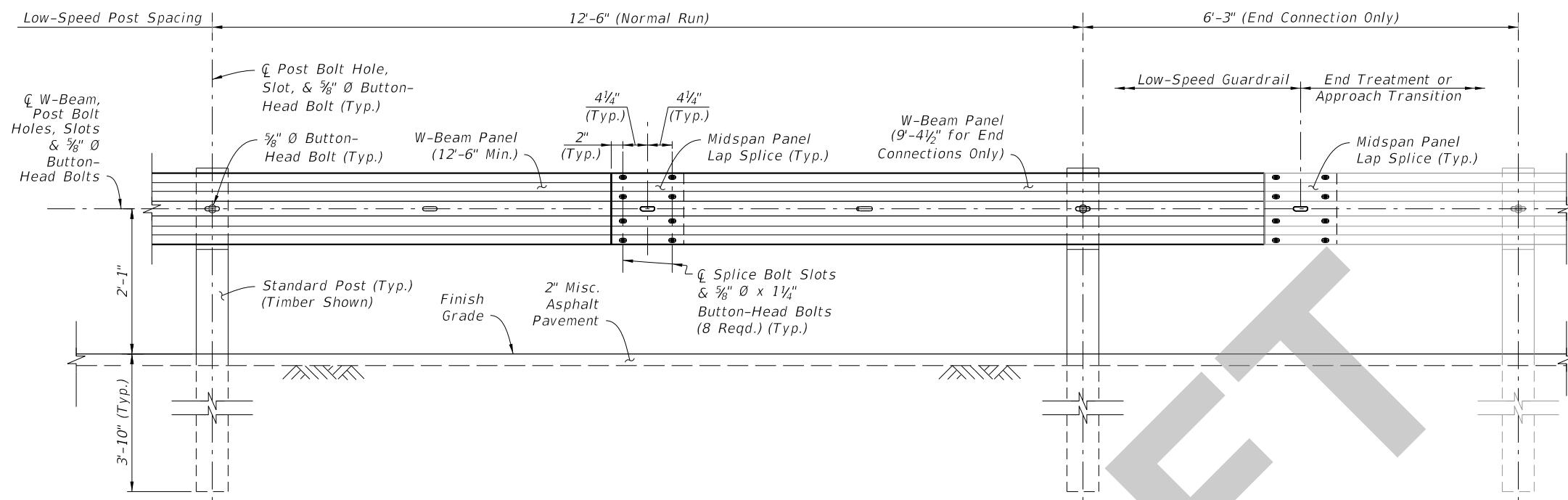
11. **PLANS CALLOUTS:** Begin/End Station labels are shown throughout this Index as they correspond to the station and offset callouts specified in the plans.

In the plans, Begin/End Guardrail Station refers to the General TL-3 Guardrail Pay Item, and it may be abbreviated as Begin/End GR. Station. Where the Low-Speed TL-2 Guardrail Pay Item is specifically required, the callout in the plans will then specify Begin/End TL-2 GR. Station.

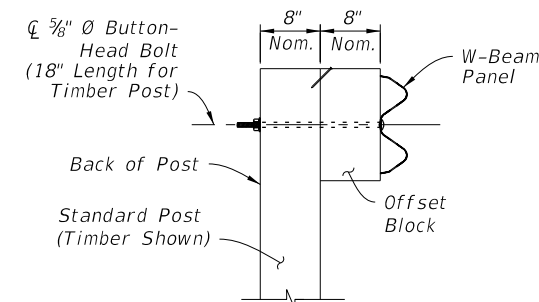
12. **QUANTITY MEASUREMENT:** Measure guardrail and corresponding components as defined in Specification 536. The Guardrail length is measured along the centerline of installed Panels, between the points labeled Begin/End Guardrail Station shown on the following Index Sheets and defined in the plans (typically measured from the \bar{C} of the panel's post bolt slots at the approach/trailing ends).

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LOW-SPEED GUARDRAIL
INSTALLED ELEVATION



INSTALLED SECTION

NOTES:

1. GENERAL: Install the Low-Speed Guardrail configuration where indicated in the plans. Low-Speed Guardrail may include tapered segments if called for in the plans.

Use 12'-6" or 25'-0" W-Beam Panels for normal spans, and use 9'-4 1/2" Panels for end connections to adjoining segments as shown. A single 6'-3" Panel may be used at the end of the Low-Speed Guardrail run along with a single reduced 6'-3" post spacing to meet the nominal Begin/End Guardrail Sta. required.

Where a differing guardrail configuration is required for constructability beyond the options shown in this Index or the Plans, obtain approval from the Engineer prior to installation.

2. MIDSPAN PANEL LAP SPLICE: For proper structural function, place all Lap Splices at midspan unless otherwise indicated.

Lap the Panels with the Splice Ridge oriented downstream of the final Direction of Traffic in the nearest traffic lane. For reverse lane conditions, orient the Splice Ridge downstream of the lane direction with the highest traffic volume. Orienting Lap Splices for Temporary Traffic Control phasing is not required.

3. CONNECTION DETAILS: Connections to End Treatments, Approach Transitions, or other segment types are defined in the following Index Sheets, APL Drawings, or the plans.

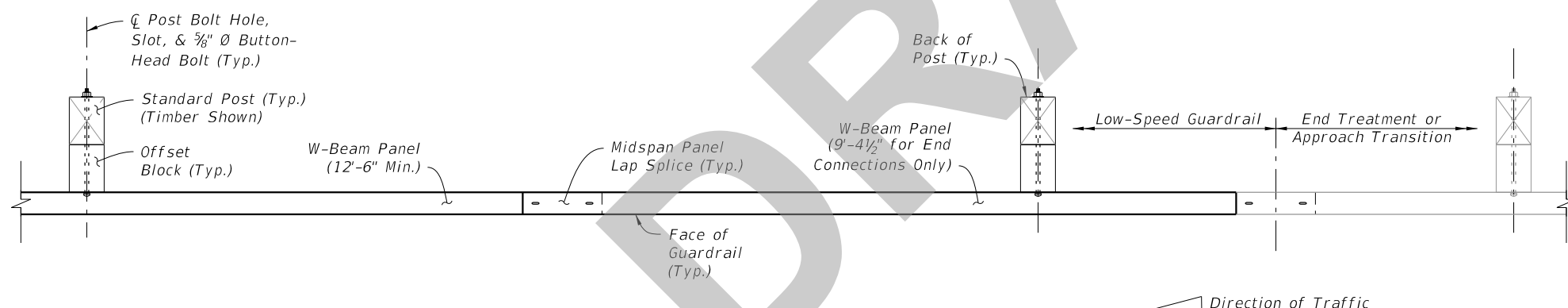
4. W-BEAM PANEL DETAILS: See Sheet 4.

5. POST & OFFSET BLOCK DETAILS: See Sheet 5.

6. GUARDRAIL SECTIONS: For Sections showing typical mounting heights, grading, and lateral offsets in relation to adjacent roadway features, see Sheet 6.

7. MODIFIED MOUNTS: Where concrete structures, concrete sidewalk, or shallow depth conditions are encountered, see Sheet 23 for additional post mounting options.

8. RESTRICTIONS: Low-Speed Guardrail segments are not permitted for use with items including, but not limited to, Double Faced W-Beam, Deep Posts at Slope Breaks, Pipe Rail, and/or Rub Rail.

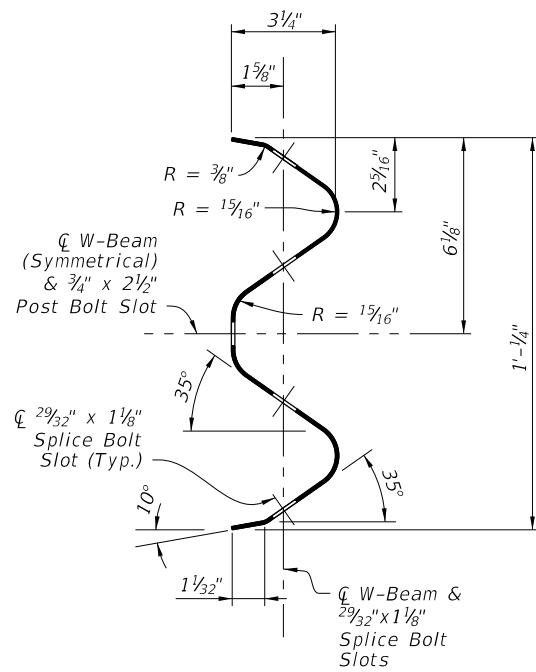


INSTALLED PLAN

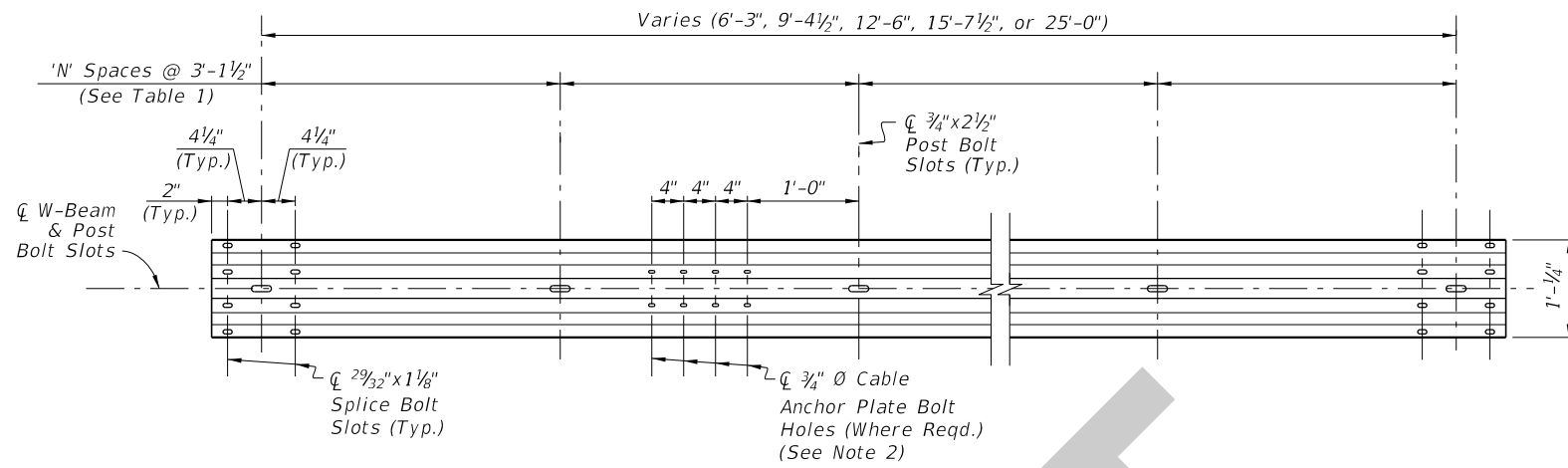
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LOW-SPEED, TL-2 GUARDRAIL DETAILS



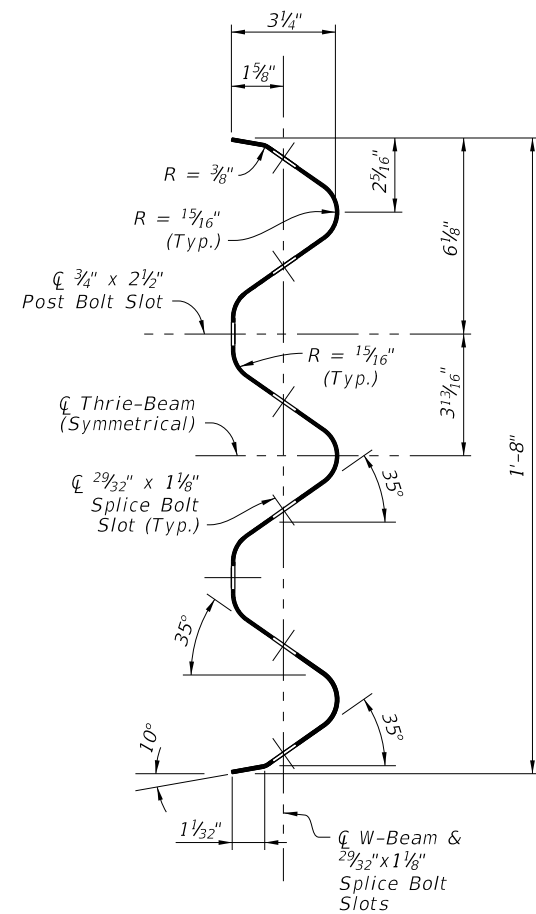
W-BEAM PANEL SECTION



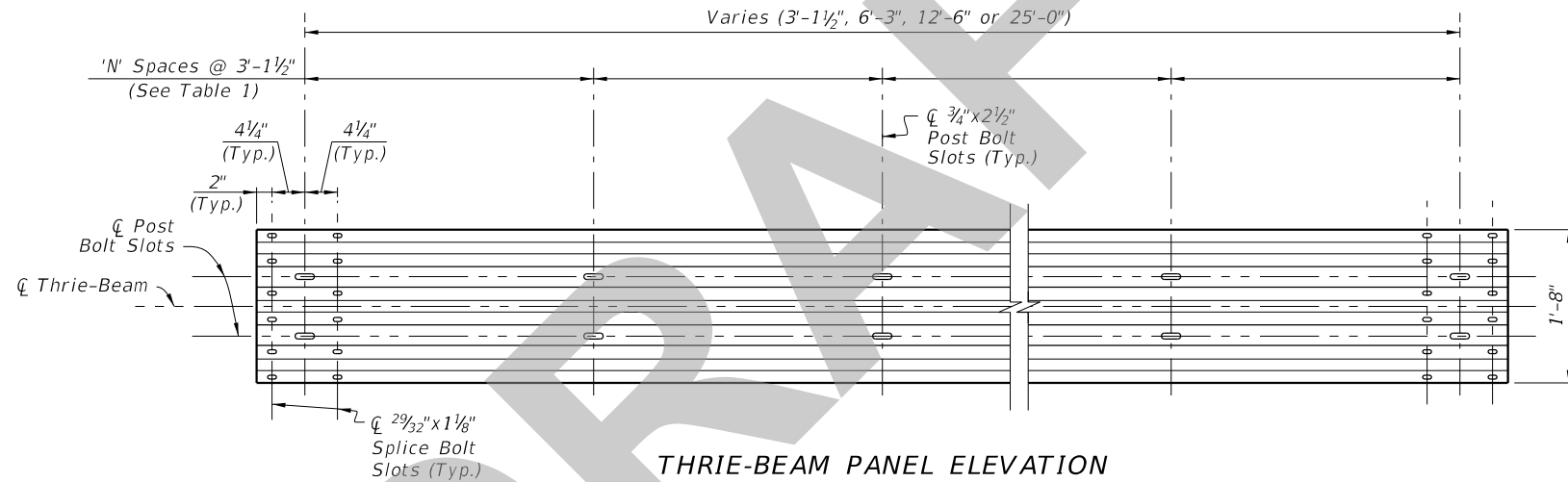
W-BEAM PANEL ELEVATION

PANEL SUMMARY TABLE:

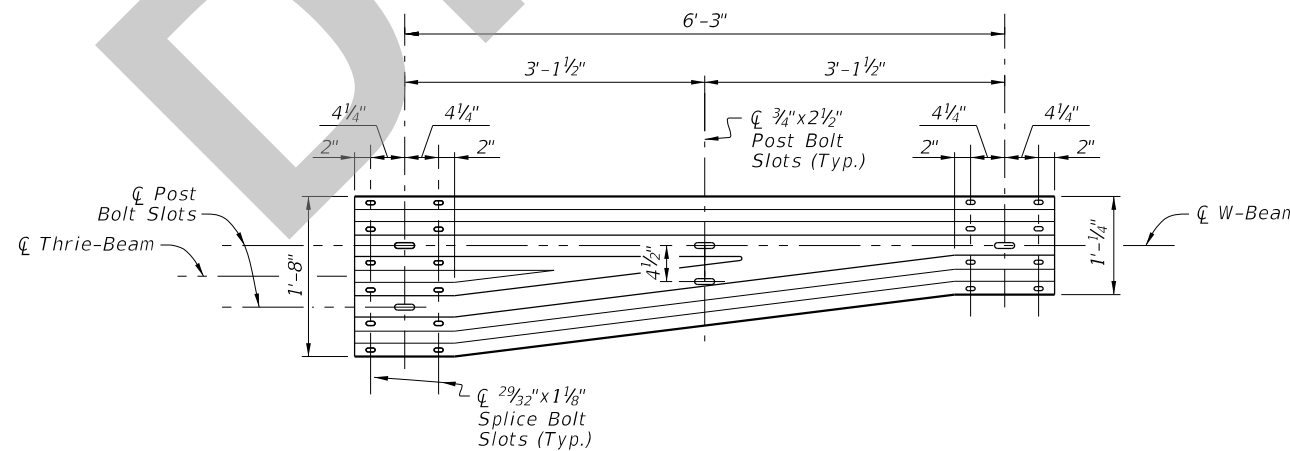
Panel Type	Number of Spaces 'N'	Gauge
6'-3" W-Beam	2	12
9'-4 1/2" W-Beam	3	12
12'-6" W-Beam	4	12
15'-7 1/2" W-Beam	5	12
25'-0" W-Beam	8	12
3'-1 1/2" Thrie-Beam	1	10
6'-3" Thrie-Beam	2	12
12'-6" Thrie-Beam	4	12
25'-0" Thrie-Beam	8	12
Thrie-Beam Trans.	2	10



THRIE-BEAM PANEL SECTION



THRIE-BEAM PANEL ELEVATION



THRIE-BEAM TRANSITION PANEL ELEVATION
(Reverse Direction Similar by Opposite Hand)

NOTES:

- MATERIALS:**
Use corrugated steel panels in accordance with Specification 967 and made from either Class A, 12 gauge steel or Class B, 10 gauge steel as specified in the 'Panel Summary Table' above.
- CABLE ANCHOR PLATE BOLT HOLES:**
Include 3/4" Ø Cable Anchor Plate Bolt Holes only where required for installation of the Cable Anchor Plate shown on Sheet 9, 10, & 11.

29/32" x 1 1/8" slots may substitute for the 3/4" Ø holes shown.

W-BEAM AND THRIE-BEAM
PANEL DETAILS

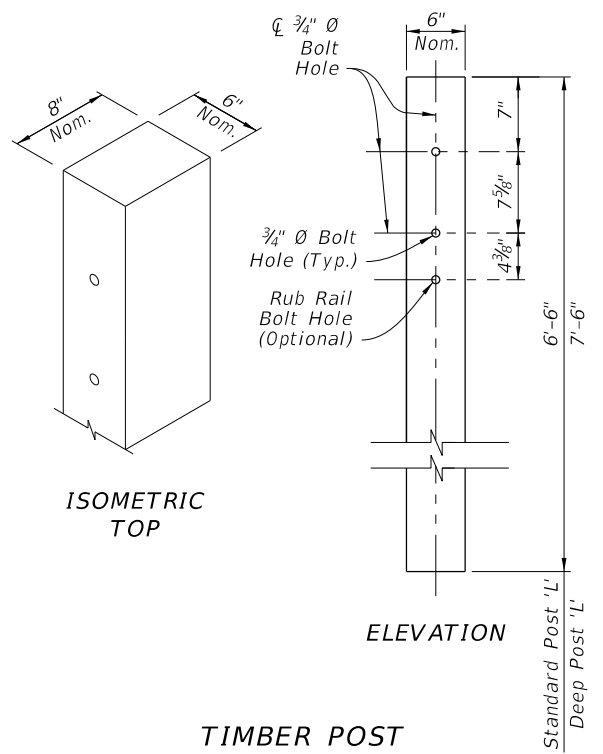
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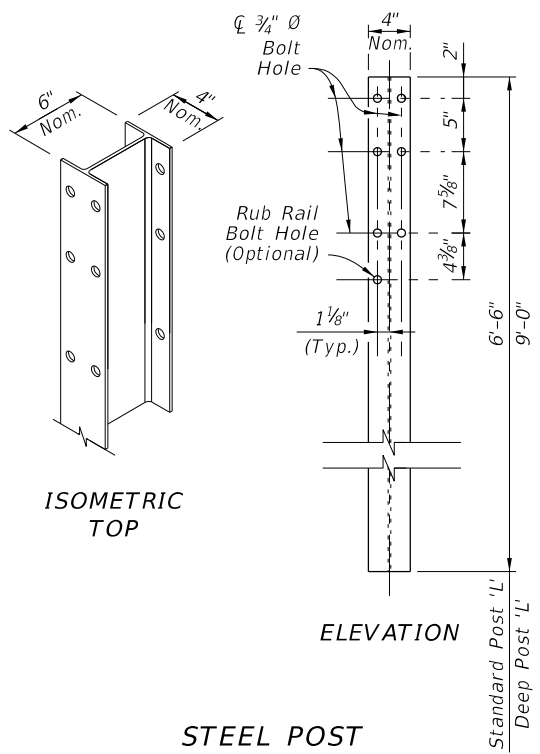
**FY 2020-21
STANDARD PLANS**

GUARDRAIL

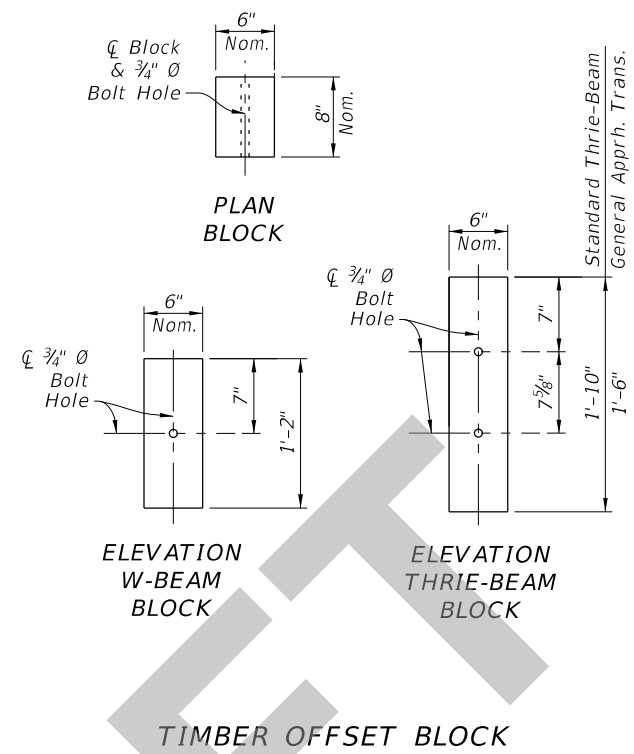
INDEX 536-001	SHEET 4 of 24
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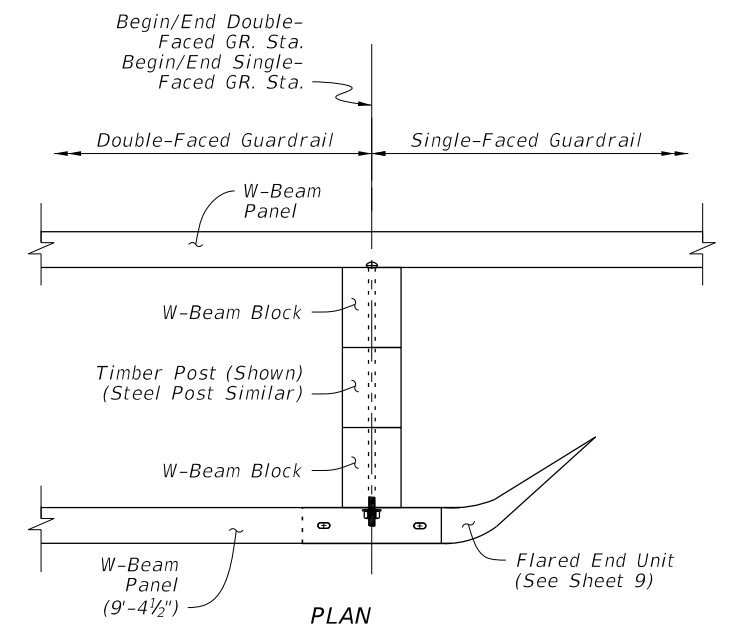
TIMBER POST
(6" X 8" Nominal)



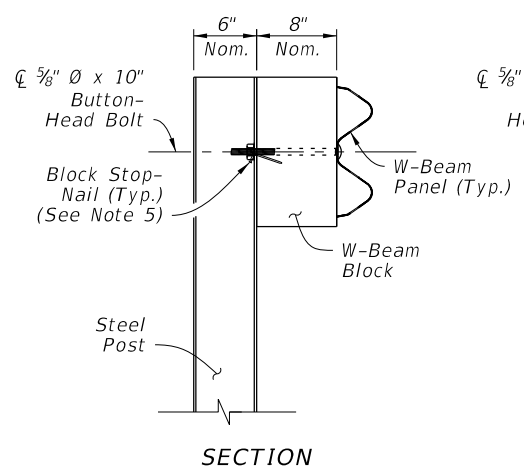
STEEL POST
(W6X8.5 or W6X9)



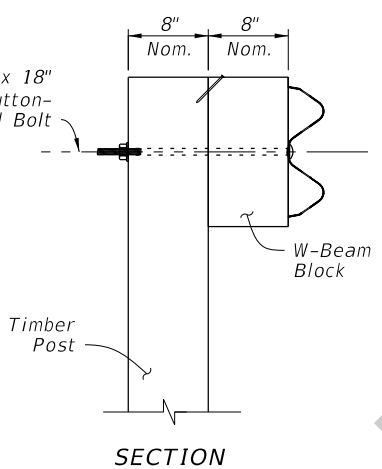
TIMBER OFFSET BLOCK
(6" X 8" Nominal)



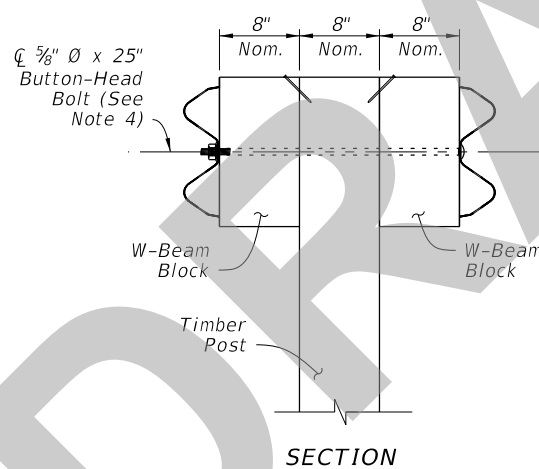
SINGLE-FACED / DOUBLE-FACED
GUARDRAIL CONNECTION



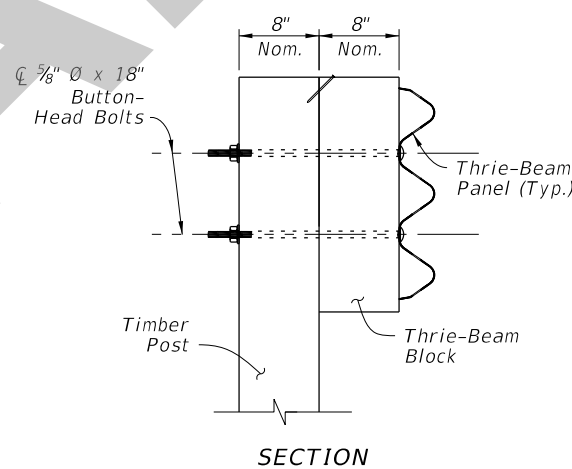
SECTION



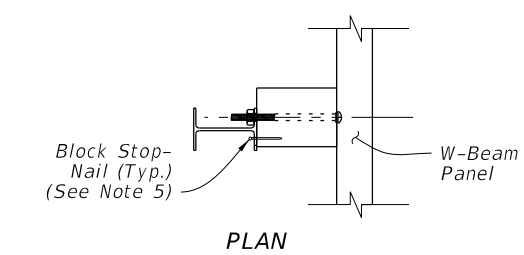
SECTION



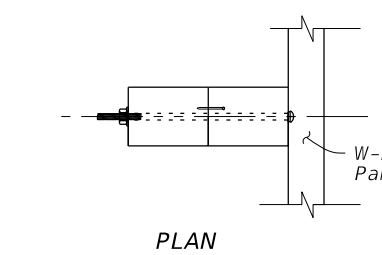
SECTION



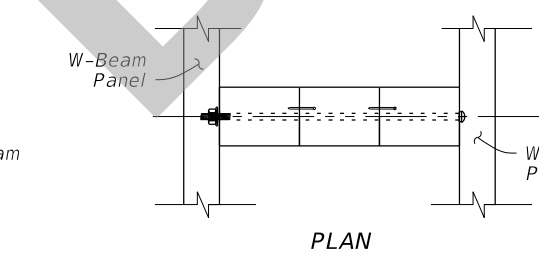
SECTION



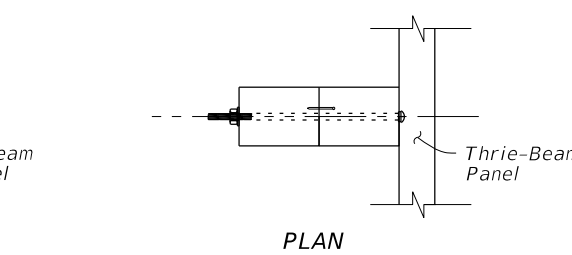
PLAN



PLAN



PLAN



PLAN

SINGLE-FACED
W-BEAM
STEEL POST

SINGLE-FACED
W-BEAM
TIMBER POST

DOUBLE-FACED W-BEAM
TIMBER POST
(Thrie-Beam Similar)
(Steel Post Similar)


THRIE-BEAM
TIMBER POST
(Steel Post Similar)

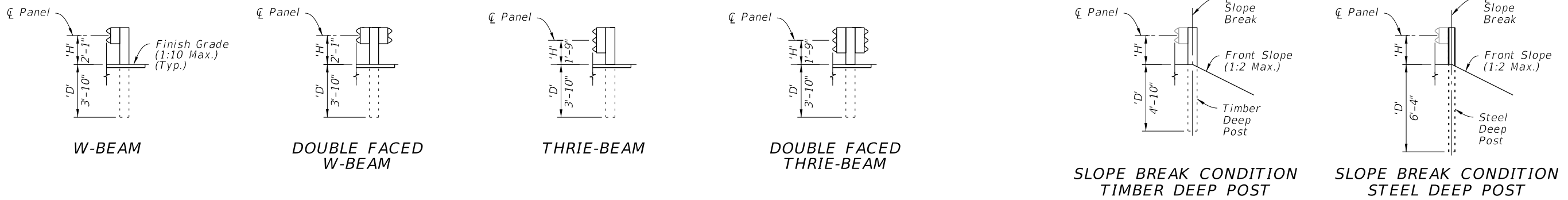
NOTES:

- STANDARD POSTS:** Where Standard Posts are called for in this Index, use either a Timber Post or Steel Post at the Length, 'L', shown for Standard Posts. Use a single post material type consistently per each run of guardrail. Only where specified in the Plans, use the Deep Post 'L' for Slope Break Conditions as shown on Sheet 6.
- OFFSET BLOCKS:** For each Panel type, install the corresponding Offset Block type as shown. For General, TL-3 (Single Faced) Approach Transitions only, use the 1'-6" Thrie-Beam Block (See Sheet 13).
- BOLT HOLES:** 3/4" Ø Bolt Holes shown in posts within this Index may be substituted with 1 1/16" Ø Bolt Holes.
- DOUBLE FACED GUARDRAIL:** Orient Post Bolts with the Button-Head located on the side nearest the traffic lane. The bolt's threaded portion is not permitted to extend beyond 3/4" from the face of the tightened nut; trim the threaded portion as needed and galvanize in accordance with Specification 562.
- BLOCK STOP-NAIL:** Drive one nail per Standard Offset Block as shown to prevent Block rotation. Use steel 3 1/2" Type 16d nails with ASTM A153 hot-dip galvanization. For steel posts, drive the nail through the unused flange Bolt Hole and bend the nail so its head contacts the flange.
- MATERIALS:** Use timber and steel posts and offset blocks in accordance with Specification 967. Composite offset blocks may be substituted as approved on the APL. Use a single offset block type consistently per each run of guardrail. Steel offset blocks are only permitted for Modified Thrie Beam.

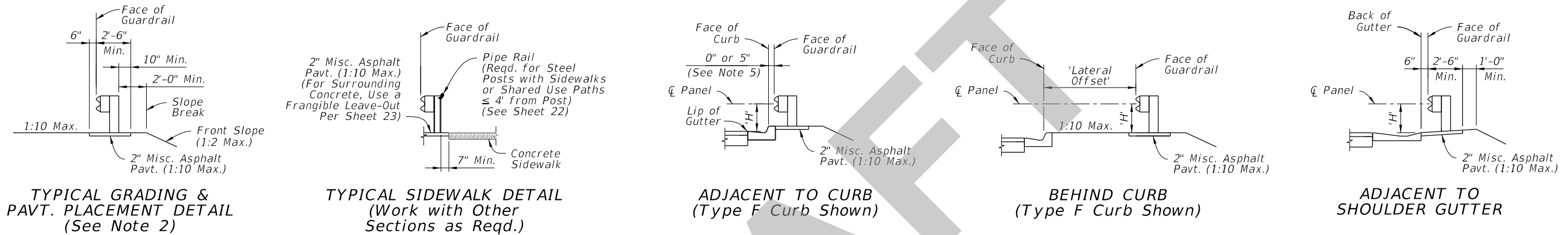
POST AND OFFSET BLOCK DETAILS

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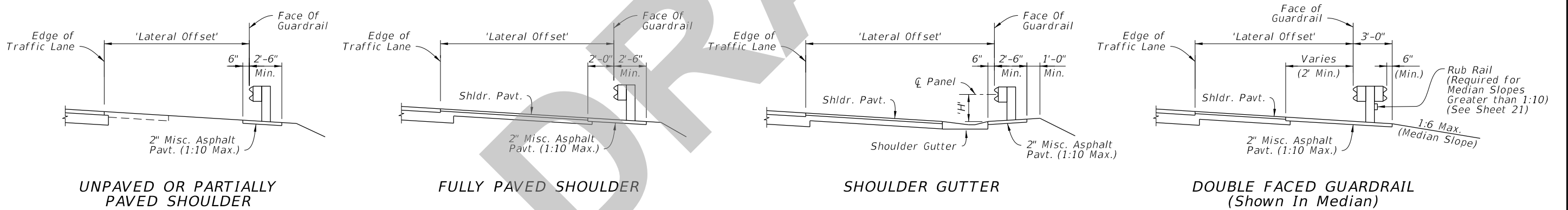


GUARDRAIL TYPES - MOUNTING HEIGHTS & POST DEPTHS



GUARDRAIL SECTIONS - TYPICAL

GUARDRAIL SECTIONS - CURB & GUTTER



GUARDRAIL SECTIONS - SHOULDERS

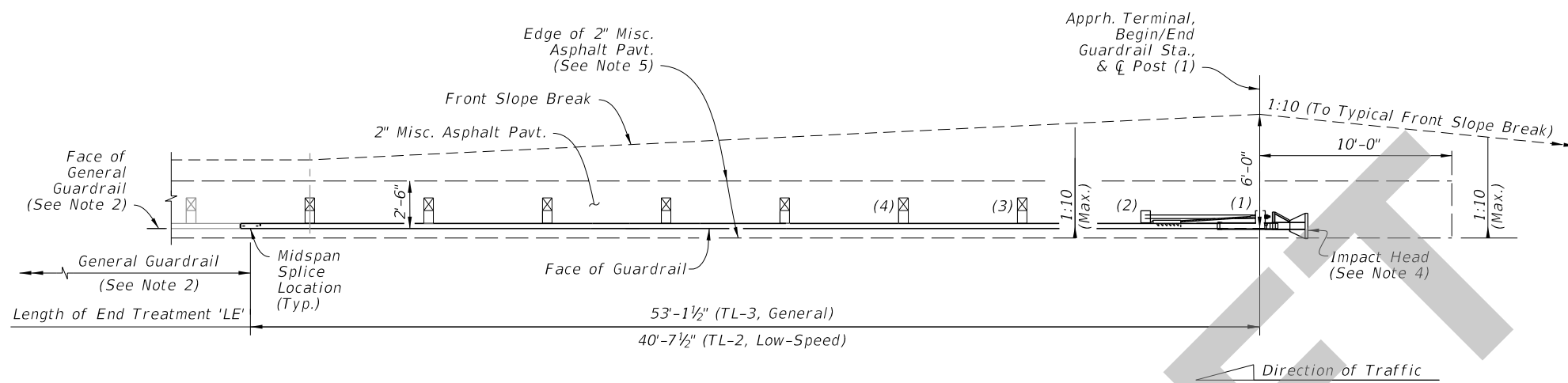
GUARDRAIL HEIGHT SUMMARY TABLE:			
Type:	Min. Depth 'D':	Mounting Height 'H':	Post Length 'L':
W-Beam (Single and Double Faced)	3'-10"	2'-1"	6'-6"
Thrie-Beam (Single and Double Faced)	3'-10"	1'-9"	6'-6"
Timber Deep Post	4'-10"	See Above	7'-6"
Steel Deep Post	6'-4"	See Above	9'-0"

NOTES:

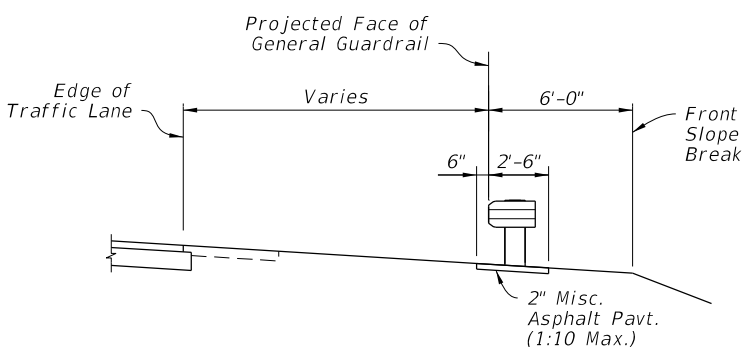
1. GUARDRAIL SECTIONS: Construct Sections as indicated in the plans. The details shown herein depict W-Beam Guardrail, but are applicable to the other defined Guardrail Types placed at the corresponding height, 'H'. Use components per Sheets 4 & 5. Steel and timber post types are interchangeable unless otherwise defined. The 1:10 Max. cross slope shown is the maximum slope permitted for proper guardrail function, but project-specific cross slope requirements are governed per the plans.
2. TYPICAL GRADING & PAVEMENT PLACEMENT DETAIL: Construct features as depicted except where superseded by specific Guardrail Sections or the plans. Place the Slope Break a Minimum of 2' behind the post. For Deep Posts, the slope break may be placed at the ϕ Post with the 2" Miscellaneous Asphalt Pavement omitted.
3. SLOPE BREAK CONDITION: Install Deep Posts only where called for in the plans. Deep Posts are only permitted where post spacing is 6'-3" or less.
4. LATERAL OFFSETS: The Lateral Offsets shown are governed by the station and offset call outs for Face of Guardrail, as shown in the plans.
5. ADJACENT TO CURB: Place the Face of Guardrail consistently offset either flush with the Face of Curb or 5" behind the Face of Curb, as indicated by the plans station and offset callout. For offset changes, transition the Face of Guardrail as shown in the plans.

GUARDRAIL SECTIONS

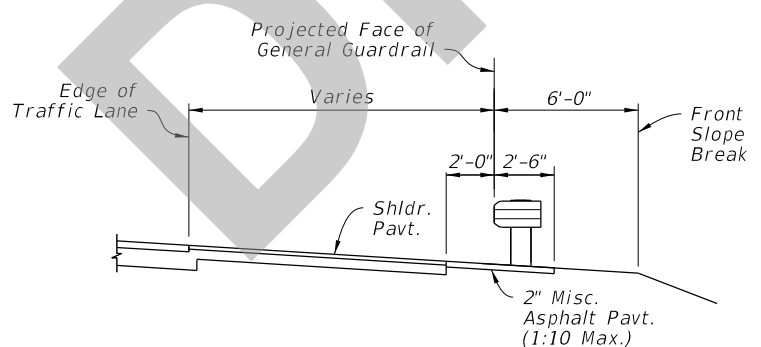
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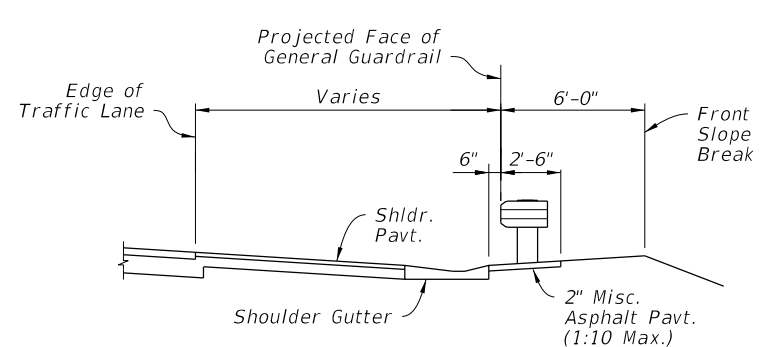
APPROACH TERMINAL ASSEMBLY
'PARALLEL' TYPE - PLAN VIEW



SECTION AT POST (1)
WITH UNPAVED SHOULDER



SECTION AT POST (1)
WITH FULLY PAVED SHOULDER



SECTION AT POST (1)
WITH SHOULDER GUTTER

END TREATMENT -
APPROACH TERMINAL
GEOMETRY - PARALLEL

NOTES:

1. **INSTALLATION:** Locate Approach Terminals where called for in the plans, with the Post (1) C placed at the Begin/End Guardrail Station indicated in the plans.

The Plan Views shown herein are schematic only, showing basic geometry for Approach Terminals listed on the APL. The predefined Length of End Treatment, 'LE', includes the proprietary portion of various Approach Terminals and provides for more consistent planning of assembly installations across the differing Approach Terminal types. Forward-anchoring style Approach Terminals may vary from the planned lengths shown by up to 3'-0".

Construct Approach Terminals as shown in the APL and in accordance with the manufacturer's unique drawing details, procedures, and specifications.

Install posts in accordance with the manufacturer's drawings. The Special Posts on Sheet 23, including Special Steel Posts, Encased Posts, and Frangible Leave-Outs, are not permitted within the Approach Terminal segment unless otherwise called for in the plans.

Align panel lap splices in accordance with the manufacturer's drawings, regardless of the direction of traffic.

Install adjacent grading, gutters, and/or curbing as shown herein.

2. **GENERAL GUARDRAIL:** General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments.

Approach Transitions, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.

3. **APPROACH TERMINAL TEST LEVEL:** Install either a Test Level 3 (TL-3) or Test Level 2 (TL-2) Approach Terminal as specified in the plans. TL-3 Approach Terminals may substitute for TL-2 Approach Terminals unless the substitution is specifically prohibited in the plans. TL-2 Approach Terminals may not substitute for TL-3 installations.

4. **IMPACT HEAD END DELINEATOR:** Apply Yellow Retroreflective Sheeting to the nose of the End Terminal in accordance with Specification 536.

5. **2" MISCELLANEOUS ASPHALT PAVEMENT:** The Plan View depicts the Unpaved Shoulder condition. For Fully Paved Shoulder and Shoulder Gutter conditions, extend the 2" Misc. Asphalt Pavement as shown in the corresponding 'Section at Post (1)' details below.

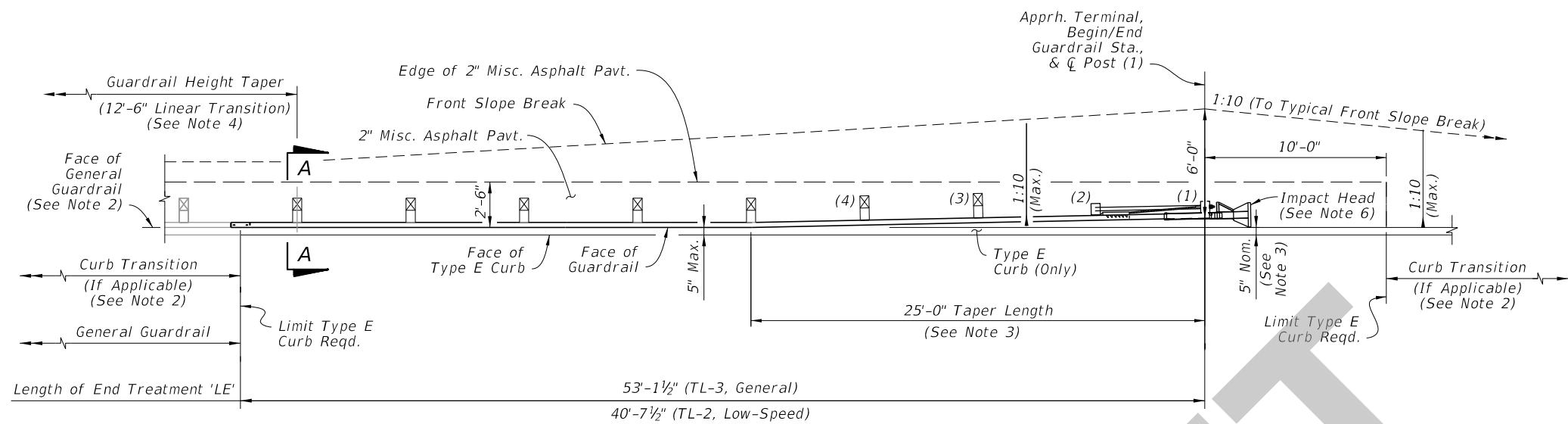
The 2" Misc. Asphalt Pavement shown upstream of Post (1) may be substituted with a different pavement type where called for in the Plans.

6. **CLEAR AREA REQUIREMENT:** Do not place any permanent aboveground installations within the areas shown with 1:10 maximum grading. For the finished condition, keep this area free of all aboveground obstructions, including dense vegetation and trees.

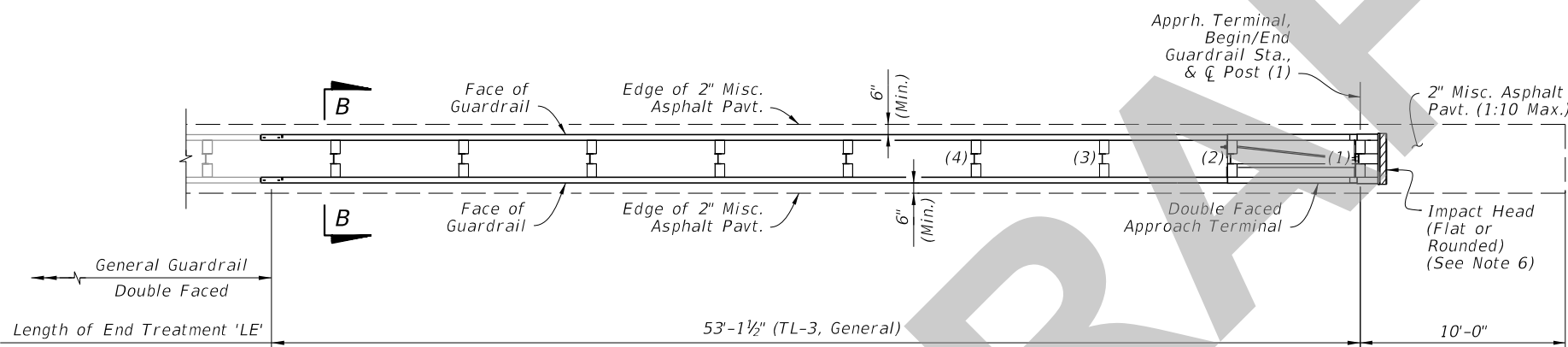
7. **'CURBED' AND 'DOUBLE FACED' GUARDRAIL SEGMENTS:** See Sheet 8.

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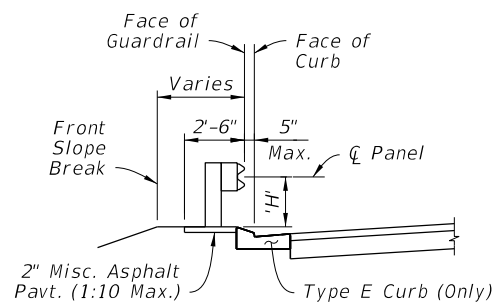
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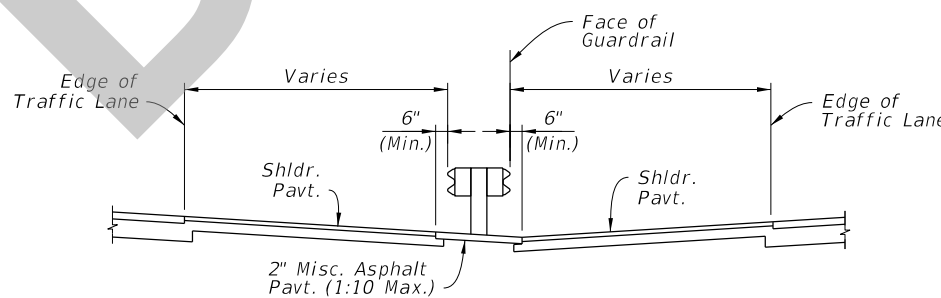
**APPROACH TERMINAL ASSEMBLY
'CURBED' SEGMENT - PLAN VIEW**



**APPROACH TERMINAL ASSEMBLY
'DOUBLE FACED' SEGMENT - PLAN VIEW**



**'CURBED' SECTION A-A
(Height, 'H', Measured from
Misc. Asphalt Pavt.)**



**'DOUBLE FACED' SECTION B-B
(1:10 Slope or Flatter Reqd.)**


NOTES:

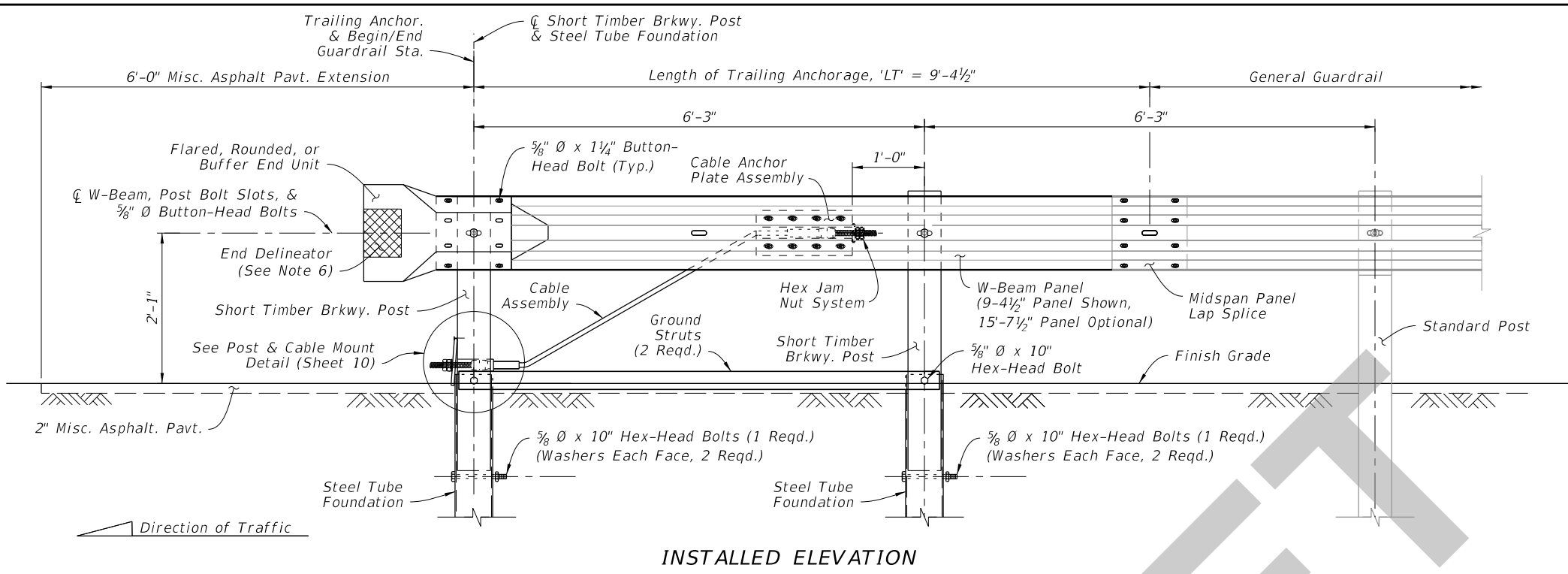
1. GENERAL: See Notes 1 through 3 on Sheet 7.
2. CURBED SEGMENTS: Type E curb is required within the limits shown. When a different curb type is called for outside of the Type E curb limits, transition the curb shape linearly, over a nominal distance ranging 5'-0" to 10'-0"
3. TAPER LENGTH: For Curbed Segments, taper the guardrail away from the roadway where shown to place the inside edge of the Impact Head at 5" behind the face of the curb. Where additional lateral offset is required to fit the Approach Terminal Assembly hardware, such as a soil plate, place the Impact Head as close to the curb as the hardware allows, not to exceed 2'-0" from the face of curb.
4. GUARDRAIL HEIGHT TAPER: For Curbed Segments, the connecting General Guardrail Mounting Height, 'H', is typically measured from the Lip of Gutter (See Sheet 6 Guardrail Sections, 'Adjacent to Curb'), while the End Terminal Assembly 'H' is measured from the Misc. Asphalt Pavt. (See Section A-A). Linearly taper the difference in Mounting Height over a minimum length of 12'-6", starting where indicated herein.
5. DOUBLE FACED SEGMENT: Connect to Double Faced General Guardrail. Use consistent Posts and Offset Block types as specified in the APL drawings over the entire Length of End Treatment, 'LE'. Posts and Offset Blocks in the adjoining General Guardrail segment may be different from those inside of the 'LE'. A change in post type between timber and steel is permitted, immediately outside of the 'LE' segment.

Maintain the 1:10 maximum grading as shown in Section B-B throughout segment 'LE'. Where required, transition to differing adjacent slopes linearly, over a minimum longitudinal length of 25'-0".
6. IMPACT HEAD END DELINEATOR: Apply Yellow Retroreflective Sheeting to the nose of the End Terminal in accordance with Specification 536.
7. CLEAR AREA REQUIREMENT: Do not place any permanent aboveground installations within the areas shown with 1:10 maximum grading. For the finished condition, keep this area free of all aboveground obstructions, including dense vegetation and trees.
8. 2" MISCELLANEOUS ASPHALT PAVEMENT: The 2" Misc. Asphalt Pavement shown upstream of Post (1) may be substituted with a different pavement type where called for in the Plans.
9. SINGLE FACED 'PARALLEL' SEGMENTS: See Sheet 7.

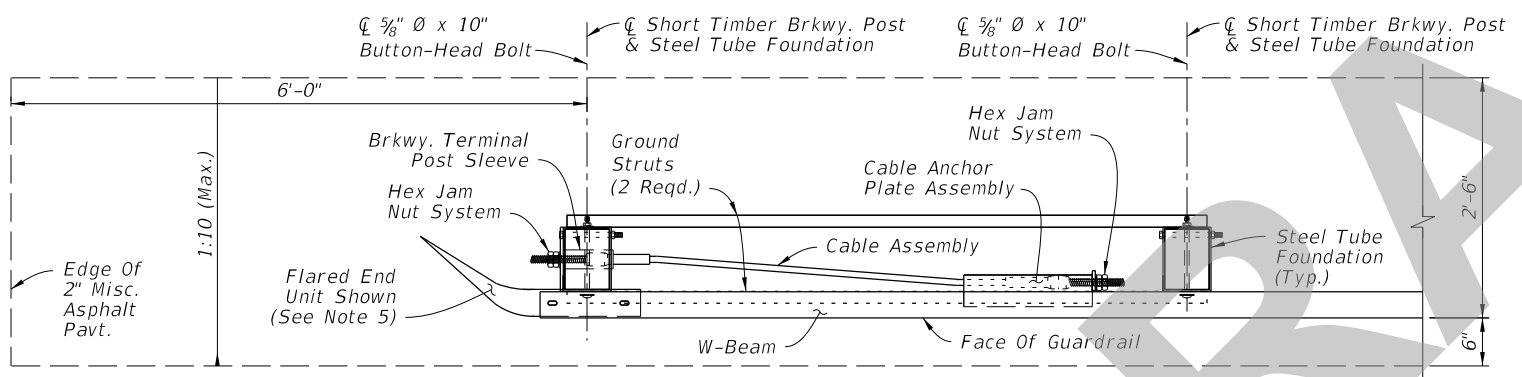
**END TREATMENT -
APPROACH TERMINAL GEOMETRY
CURBED AND DOUBLE FACED**

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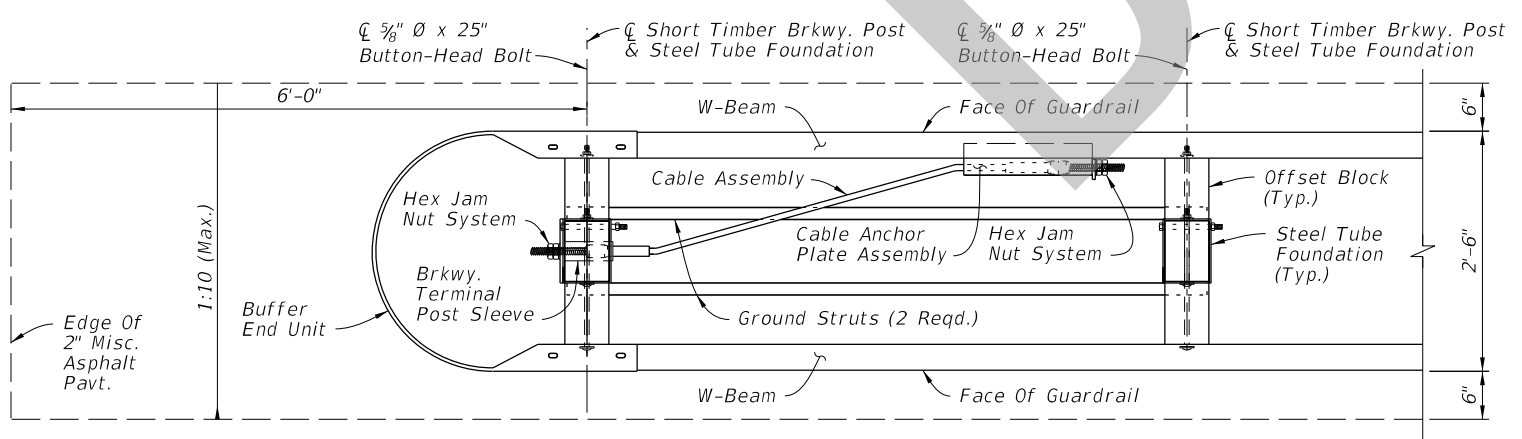
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INSTALLED ELEVATION



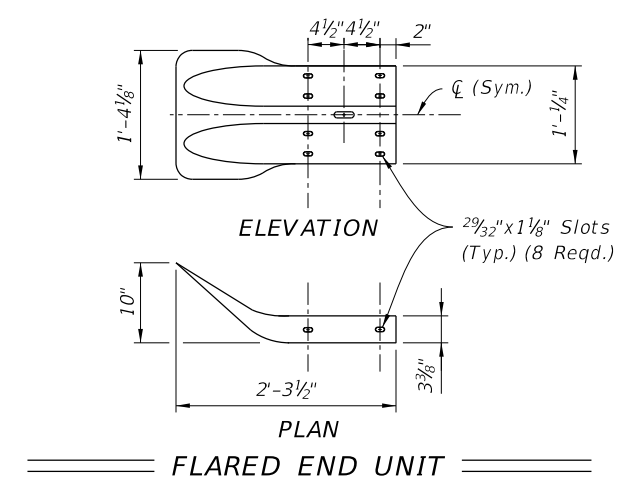
SINGLE FACE TRAILING ANCHORAGE INSTALLED PLAN



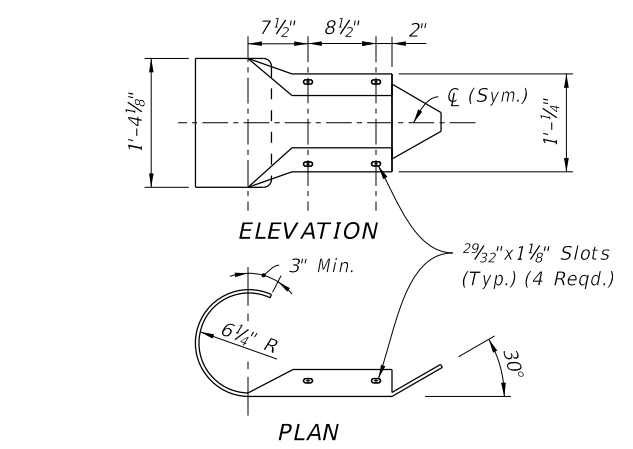
DOUBLE FACE TRAILING ANCHORAGE INSTALLED PLAN

NOTES:

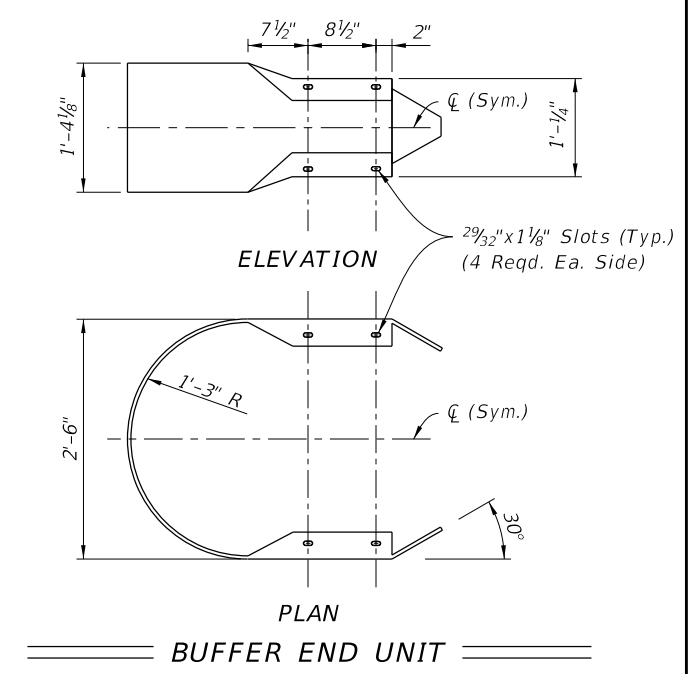
- COMPONENT DETAILS:** For additional component details, See Sheet 10.
- END UNITS:** Use materials for end units as defined in Specification 967. End Units are referred to as "End or Buffer Sections" in AASHTO M180.
Lap the Flared End Unit behind the W-Beam; lap the Rounded and Buffered End Units over the face of the W-Beam.
- FOUNDATIONS:** Install Steel Tubes with attached Soil Plates by either of the following methods:
 - Excavate, backfill, and compact material to provide full passive soil resistance to all surfaces of the Tube and Soil Plate.
 - Drive the Tube and Soil Plate as a single unit using a dummy timber post to prevent damage to the Breakaway Post.
- GENERAL GUARDRAIL:** General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Transitions, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.
- SIDEWALK REQUIREMENTS:** When sidewalks are located adjacent to the End Treatment, install a Rounded End Unit (Flared End Unit not permitted for this case).
- END DELINEATOR:** Mount retroreflective sheeting to the approach face of the End Unit in accordance with Specifications 536 and 967.



FLARED END UNIT




ROUNDED END UNIT

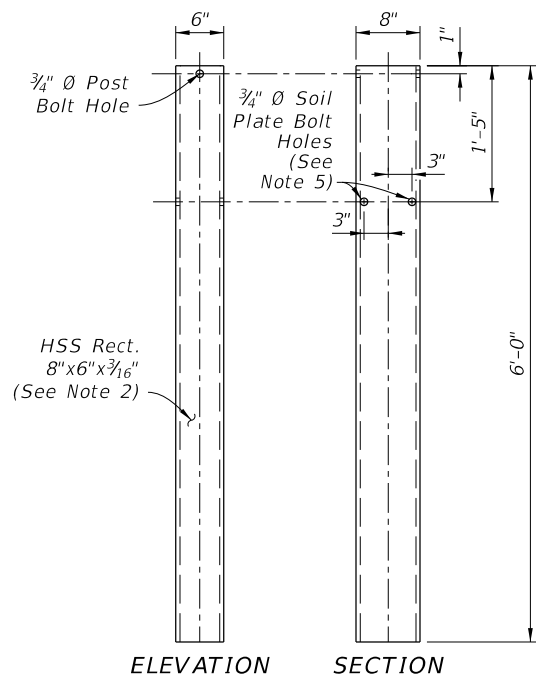


BUFFER END UNIT

END TREATMENT - TRAILING ANCHORAGE

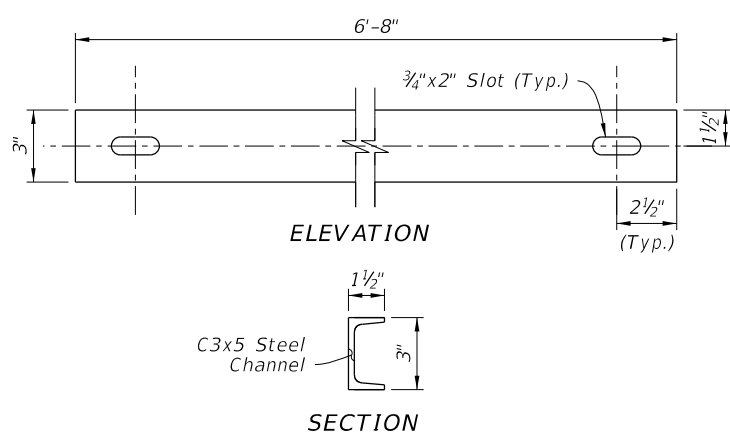
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ELEVATION SECTION

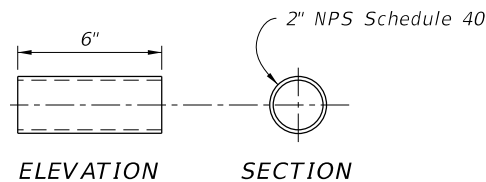
STEEL TUBE FOUNDATION



ELEVATION

SECTION

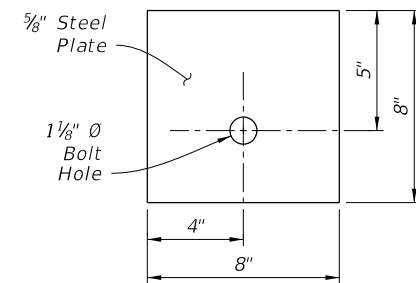
GROUND STRUT



ELEVATION

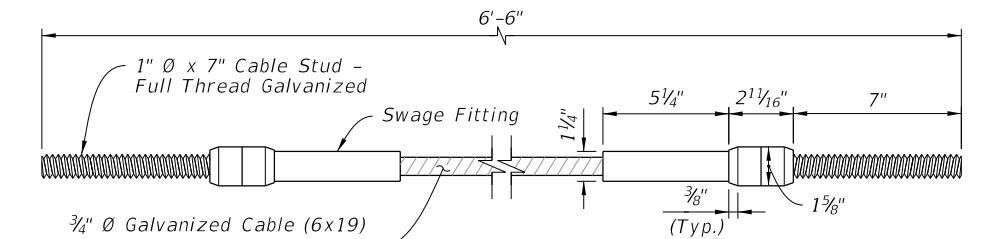
SECTION

BREAKAWAY TERMINAL POST SLEEVE



SECTION

BEARING PLATE



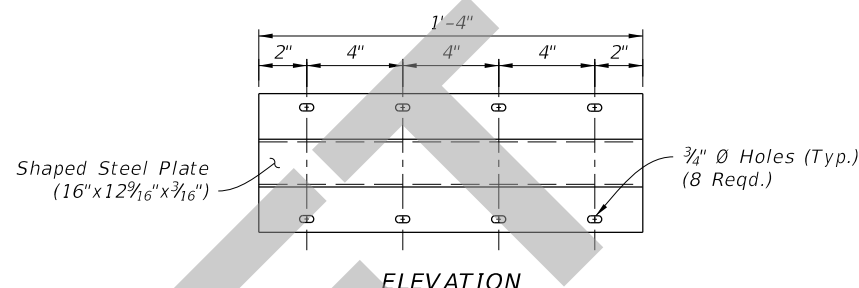
6'-6"

1" Ø x 7" Cable Stud - Full Thread Galvanized

Swage Fitting

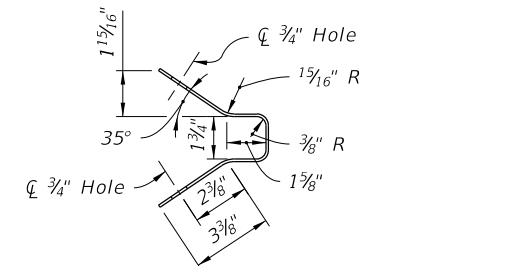
3/4" Ø Galvanized Cable (6x19) Swage Connected To Anchor Studs

CABLE ASSEMBLY

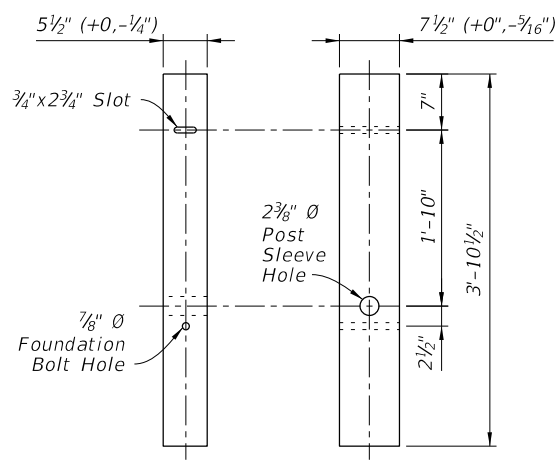


ELEVATION

CABLE ANCHOR PLATE

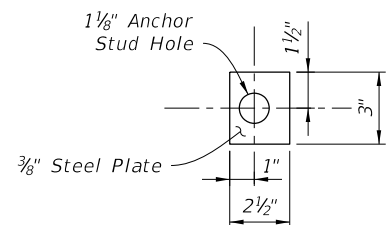


SECTION

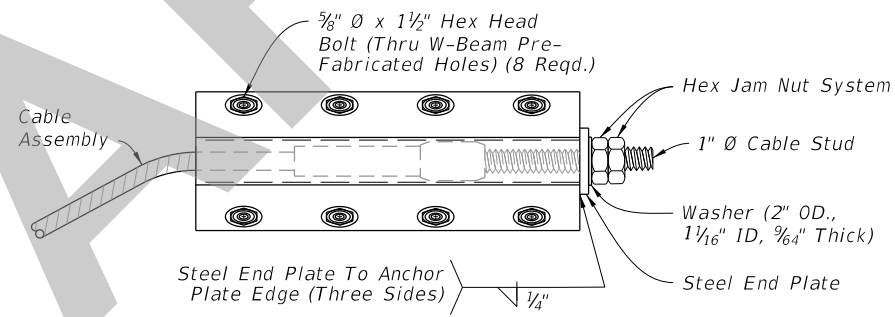


ELEVATION SECTION

SHORT TIMBER BREAKAWAY POST (6"x8" Nom.)

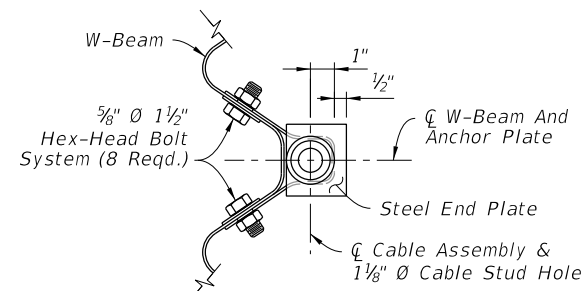


STEEL END PLATE

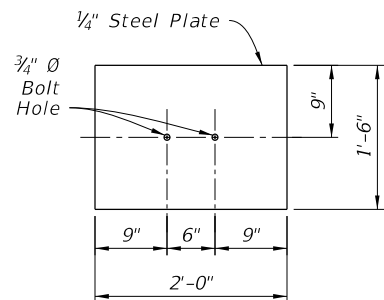


ELEVATION

CABLE ANCHOR PLATE ASSEMBLY

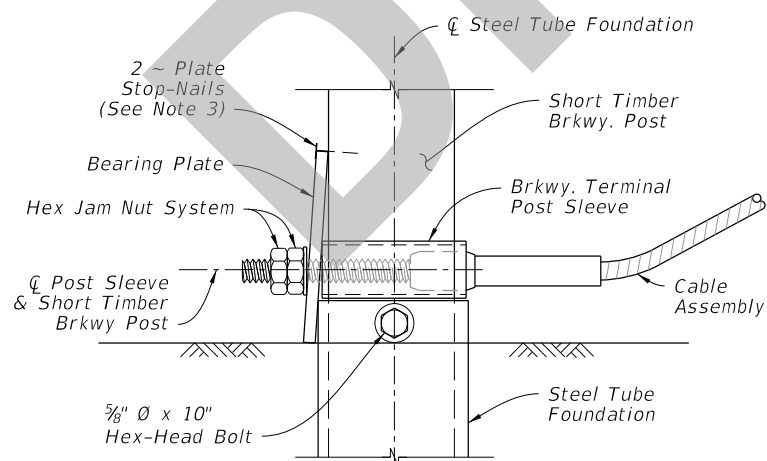


SECTION



SECTION

SOIL PLATE



ELEVATION

POST & CABLE MOUNT ASSEMBLY

NOTES:

1. INSTALLATION: Use components as shown on Sheets 9 & 11.
2. MATERIALS: Use steel plates, channels, and Cable Assemblies in accordance with Specification 967. Use Short Timber Breakaway Posts and Steel Tube Foundations in accordance with Specification 536. Use Hex Nuts, Hex Jam Nuts, and Washers in accordance with the AASHTO-AGC-ARTBA Guide to Standardized Barrier Hardware with English unit equivalents of components FN24a and FWC24a, respectively. Two Hex Nuts may be used for the Hex Jam Nut System.
3. PLATE STOP-NAILS: To prevent rotation of the Bearing Plate, drive steel 2 1/2" Type 8d nails with ASTM A153 hot-dip galvanization.
4. CABLE ANCHOR PLATE ASSEMBLY INSTALLATION: Mount to the pre-fabricated Cable Anchor Plate Bolt Holes in the W-Beam Panel, as shown on Sheet 4. These panel holes are only permitted for this Cable Anchor Plate Assembly application.
5. SOIL PLATE BOLT HOLE(S): For Trailing Anchorage installations as shown on Sheet 9, the two bolt holes shown may be substituted with a single bolt hole located at the tube centerline.

END TREATMENT - COMPONENT DETAILS

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11/01/19	

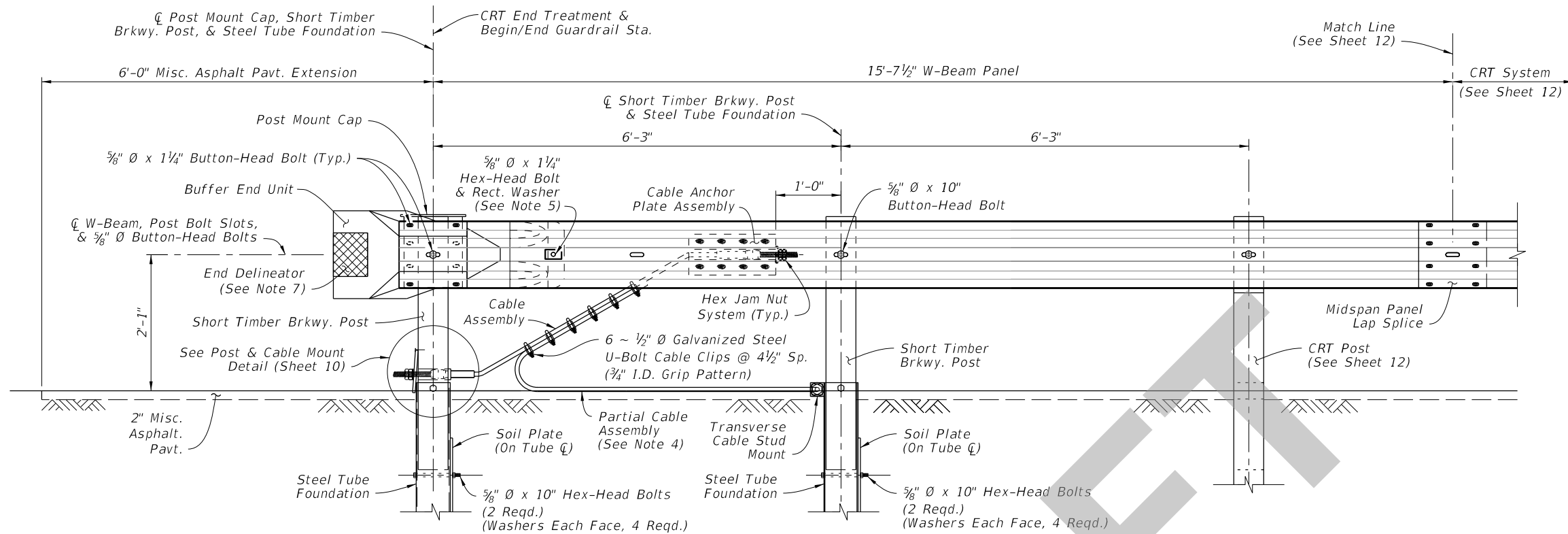


FY 2020-21 STANDARD PLANS

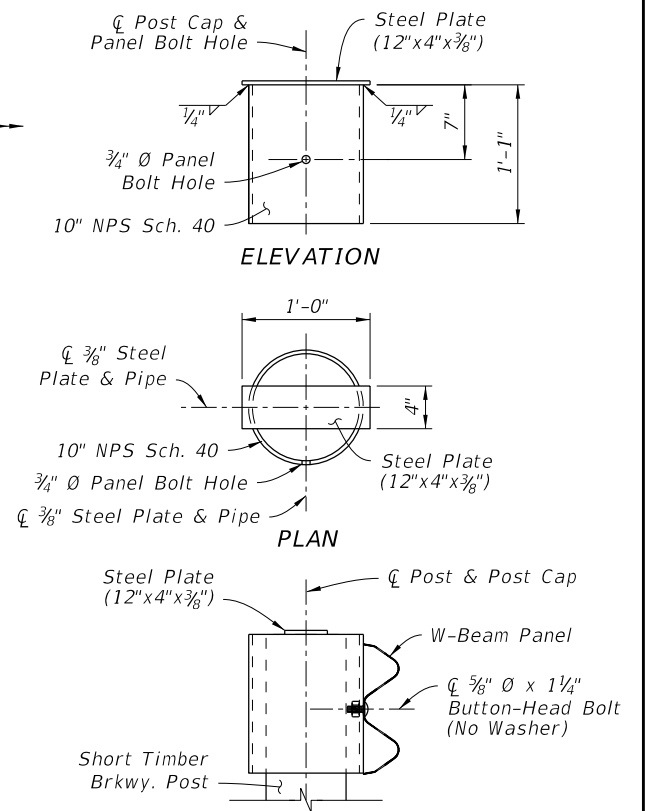
GUARDRAIL

INDEX 536-001

SHEET 10 of 24

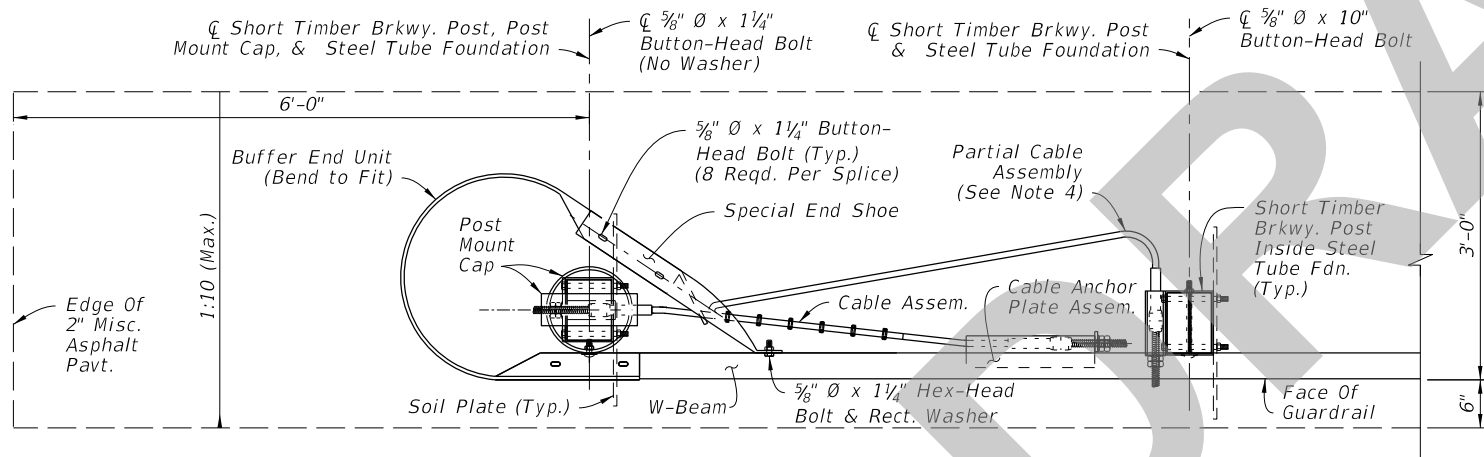


INSTALLED ELEVATION



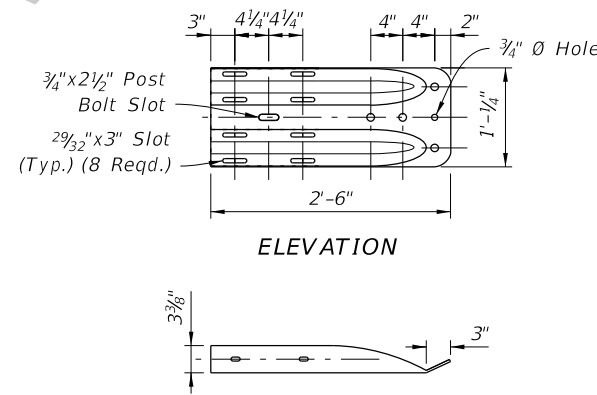
INSTALLED SECTION

POST MOUNT CAP



INSTALLED PLAN

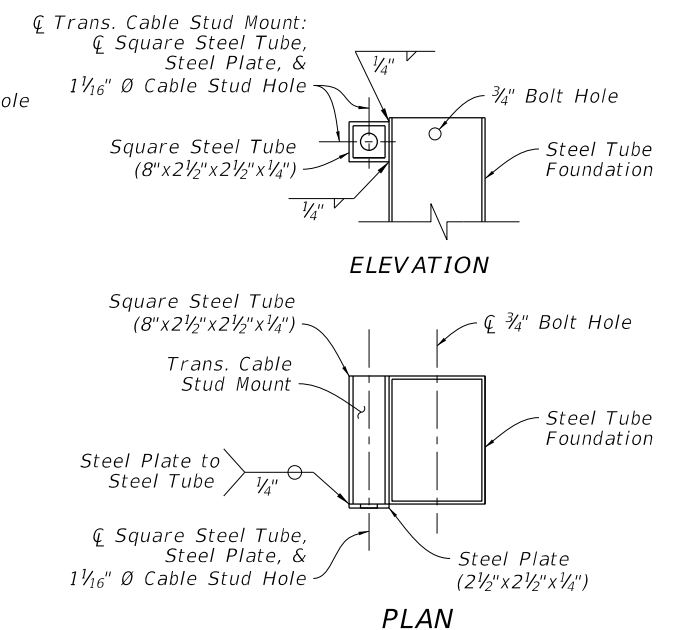
CRT END TREATMENT ASSEMBLY



ELEVATION

PLAN

SPECIAL END SHOE



ELEVATION

PLAN

TRANSVERSE CABLE STUD MOUNT

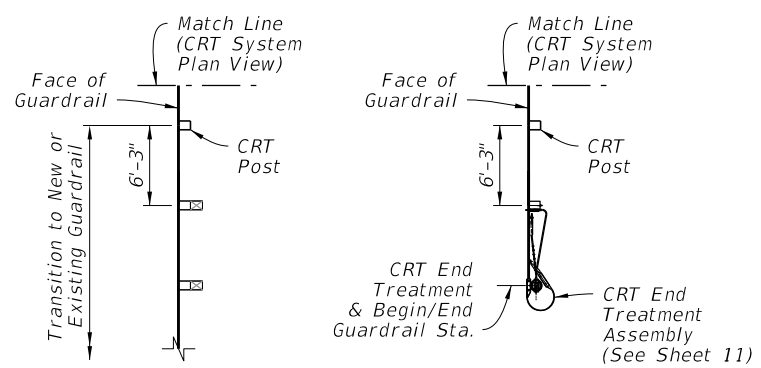
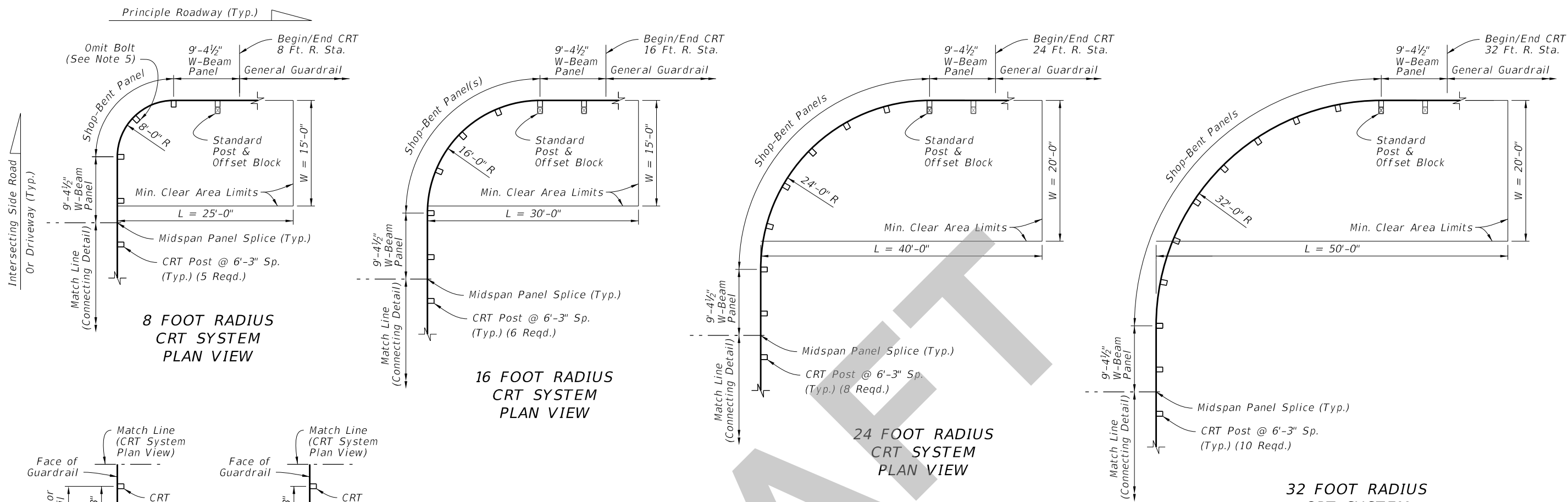
NOTES:

- INSTALLATION:** Use with CRT Systems as required on Sheet 12.
- COMPONENT DETAILS:** For additional component details, See Sheet 10 & 12. For the Rectangular Washer detail, see Sheet 24.
- MATERIALS:** Use steel End Shoes, Plates, Tubes, and pipes in accordance with Specification 967.
- PARTIAL CABLE ASSEMBLY:** The Partial Cable Assembly is similar to the Cable Assembly defined on Sheet 10, except with a 9'-0" total length and the Swage Fitting and Cable Stud omitted from one end.
Feed the Cable Stud through the Cable Stud Hole of the Transverse Cable Stud Mount as shown, and secure it with the Hex Jam Nut System as defined on Sheet 10.
- SPECIAL END SHOE MOUNT:** Punch a 3/4" diameter hole in the W-Beam Panel as needed to secure the Special End Shoe with the 5/8" diameter Hex-Head Bolt. Galvanize hole per Specification 562.
- FOUNDATIONS:** Install Steel Tubes with attached Soil Plates by either of the following methods:
 - Excavate, backfill, and compact material to provide full passive soil resistance to all surfaces of the tube and soil plate.
 - Drive the steel tube and soil plate as a single unit using a dummy timber post to prevent damage to the breakaway post.
- END DELINEATOR:** Mount retroreflective sheeting to the approach face of the Buffer End Unit in accordance with Specifications 536 and 967.

END TREATMENT - CONTROLLED RELEASE TERMINAL (CRT) SYSTEM

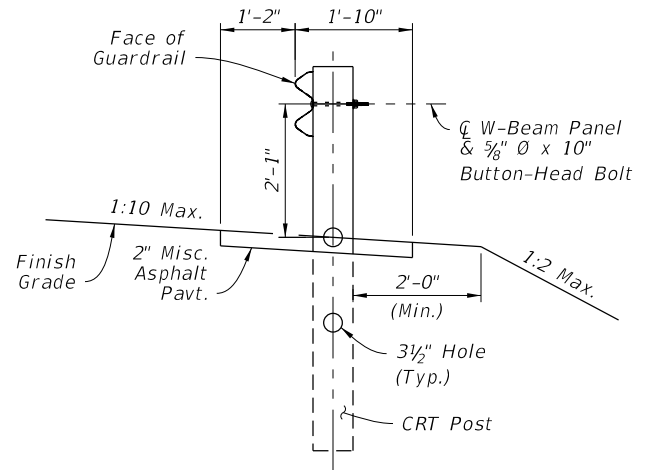
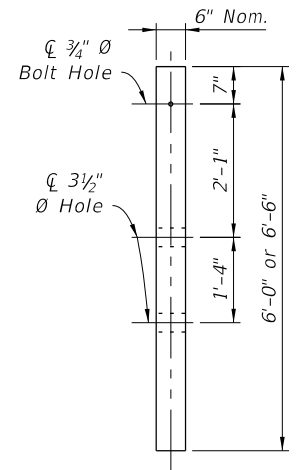
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CRT SYSTEM SUMMARY TABLE:

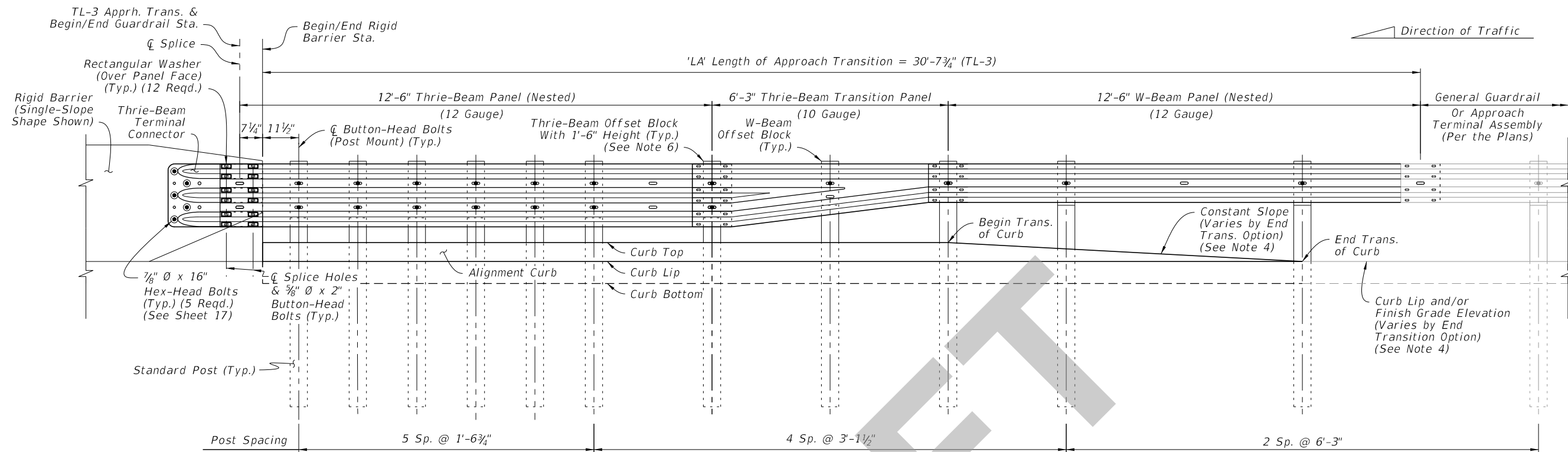
RETURN RADIUS (FT.)	LENGTH OF SHOP-BENT PANEL(S) (FT.)	QUANTITY OF CRT POSTS	AREA CLEAR OF HAZARDS 'L' x 'W' (FT.)
8	12.5	5	25 x 15
16	25.0	6	30 x 15
24	37.5	8	40 x 20
32	50.0	10	50 x 20



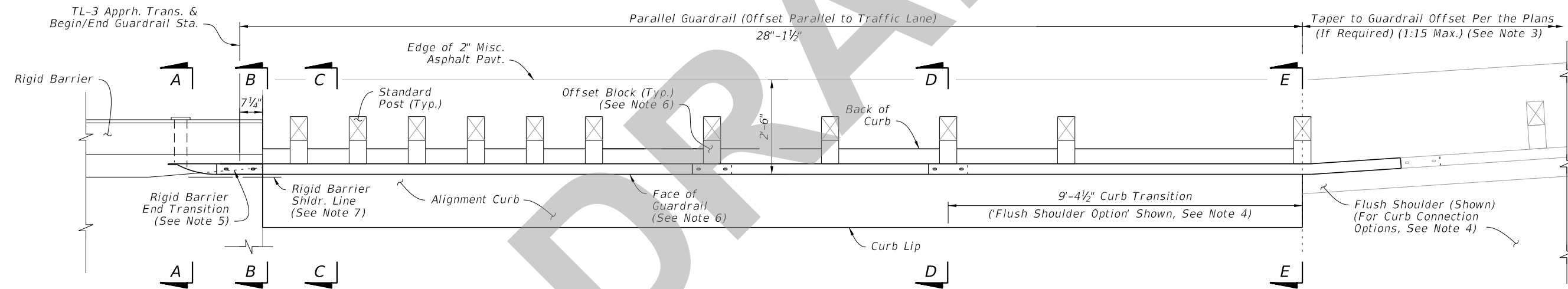
- NOTES:**
- INSTALLATION:** Construct the specified radius layout and Connecting Detail option as shown in the plans.
 - MIN. CLEAR AREA:** Keep the area behind the CRT free of fixed objects and aboveground hazards within the Min. Clear Area limits shown. Maintain a slope not steeper than 1:10 for a minimum 2' behind the posts, and maintain a slope not steeper than 1:2 beyond 2' from the posts.
 - APPROACH GRADING:** Maintain grading on the roadway side of the guardrail face at a maximum slope of 1:10.
 - MATERIALS:** For CRT Posts, use Timber Post material in accordance with Specification 967. Use steel panels and hardware in accordance with Specification 967.
 - BOLT OMISSION:** For the 8 Foot Radius CRT System only, do not place a panel-to-post mount bolt at the center CRT Post (omit the 5/8" Button-Head Bolt only at the location shown).
 - SHOP-BENT PANELS:** Install Shop-Bent panel(s) where indicated using 12'-0" or 25'-0" W-Beam Panels. Splice at post locations within the CRT radius using the General configuration of 5/8" diameter Button-Head Bolts (8 reqd. per splice).
 - GENERAL GUARDRAIL:** General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Approach Transitions, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.

LAYOUT FOR CONTROLLED RELEASE TERMINAL (CRT) SYSTEMS - SIDE ROADS AND DRIVEWAYS

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TL-3 APPROACH TRANSITION
INSTALLED ELEVATION



TL-3 APPROACH TRANSITION
INSTALLED PLAN

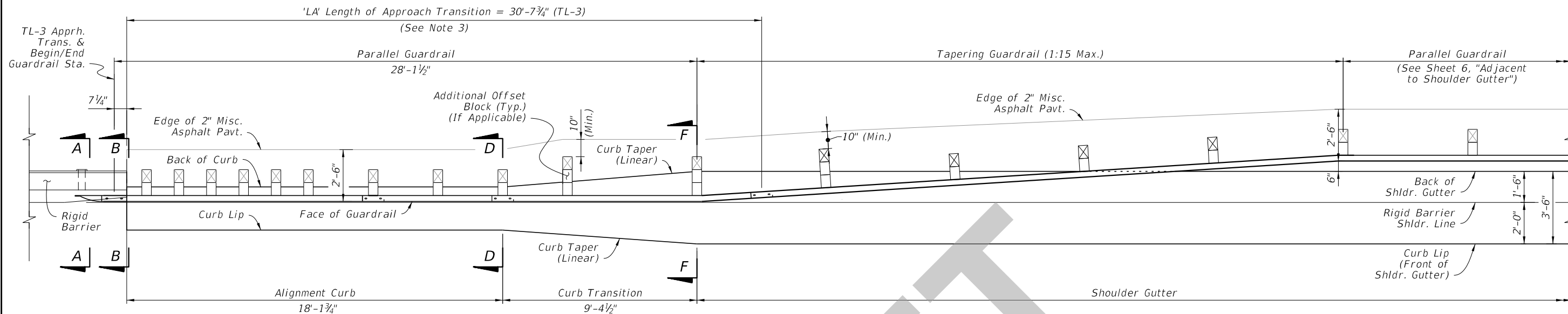
NOTES:

- INSTALLATION:** Construct the Approach Transition segment where indicated in the plans. For example Layouts showing the Approach Transition's fit among other guardrail segments, see Sheet 19.
For existing bridge connection options, see Indexes 536-002, 521-404, and 521-405.
- SECTION VIEWS & DETAILS:** For cross sections and details, including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 17.
- GUARDRAIL TAPER:** The connecting guardrail may require a different lateral offset if shown in the plans. At the location shown herein, taper the guardrail to the connecting guardrail offset. If the adjacent guardrail segment has the same offset as the Approach Transition segment, then no taper is required.
- END TRANSITION OF CURB OPTIONS:** The Plan and Elevation views depict an example Curb Transition to Flush Shoulder from Section D-D to E-E, but this transition may require a different shape depending on the End Transition option shown in the plans (Either a 'Shoulder Gutter Option', 'Raised Curb Option', or 'Flush Shoulder Option'). See Sheet 14 for additional curb options and Sheet 17 for curb shape details.
- RIGID BARRIER END TRANSITION:** Taper the Rigid Barrier toe as shown. See Concrete Barrier, Index 521-001, and Traffic Railing, Indexes 521-422 and 521-428, for details.
- OFFSET BLOCKS:** For Thrie-Beam post locations within the Length of Approach Transition segment, use the Timber Offset Blocks with 1'-6" height shown on Sheet 5.
For the midspan of the Thrie-Beam Transition Panel and for all other W-Beam locations shown herein, use the W-Beam Offset Blocks with 1'-2" height.
- OFFSET:** The required offset difference between the Face of Guardrail and Rigid Barrier Shoulder Line is considered negligible and may not be shown in the guardrail offset callouts in the plans. A consistent guardrail offset deviation of up to 4 inches outside of the Rigid Barrier Shoulder Line is permitted over the length 'LA'.
- GENERAL GUARDRAIL:** General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Approach Terminals, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.

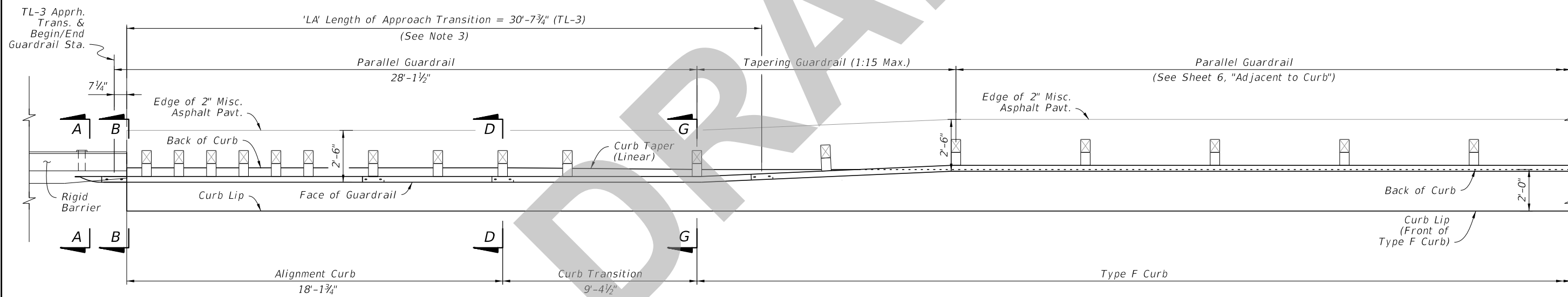
APPROACH TRANSITION CONNECTION
TO RIGID BARRIER - GENERAL, TL-3

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TL-3 APPROACH TRANSITION WITH 'SHOULDER GUTTER' CONNECTION - PLAN VIEW




TL-3 APPROACH TRANSITION WITH 'TYPE F CURB' CONNECTION - PLAN VIEW

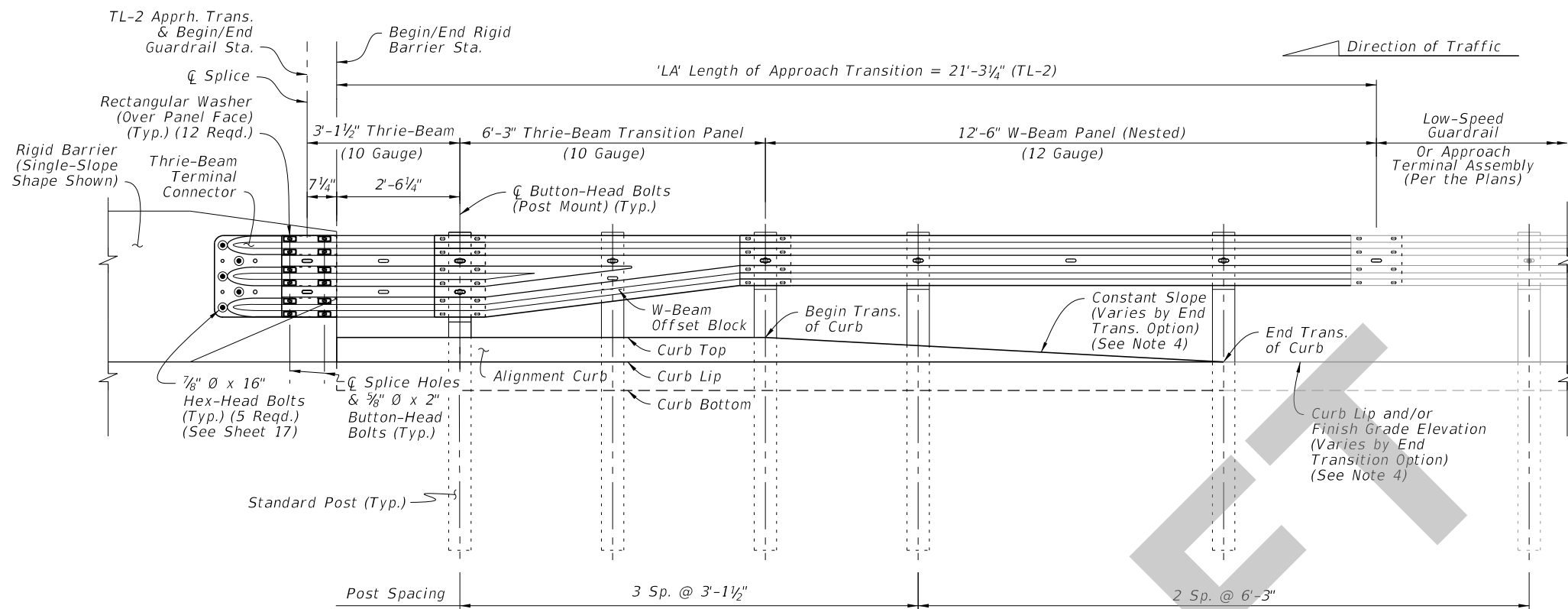
NOTES:

1. GENERAL: See the applicable notes and details on Sheet 13.
2. SECTION VIEWS & DETAILS: For cross sections and details, including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 17.
3. ELEVATION VIEW: For post and panel installation details within 'LA', see the elevation view on Sheet 13. The curb details will differ depending on curb option required.

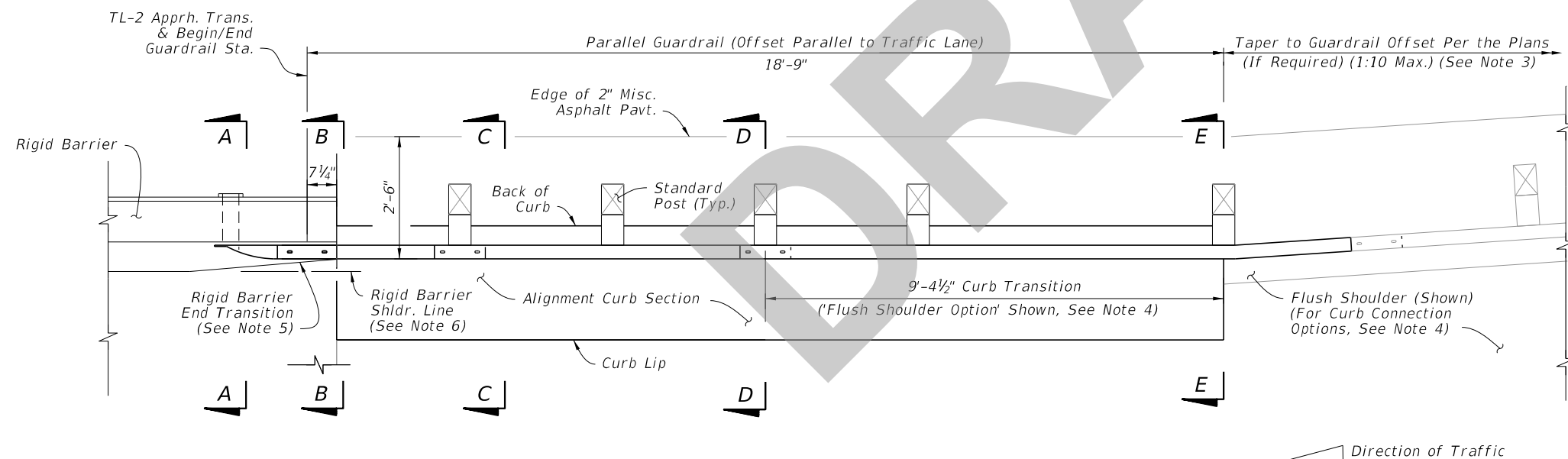
APPROACH TRANSITION CONNECTION TO RIGID BARRIER - GENERAL, TL-3 CURB CONNECTIONS

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**TL-2 APPROACH TRANSITION
INSTALLED ELEVATION**



**TL-2 APPROACH TRANSITION
INSTALLED PLAN**


NOTES:

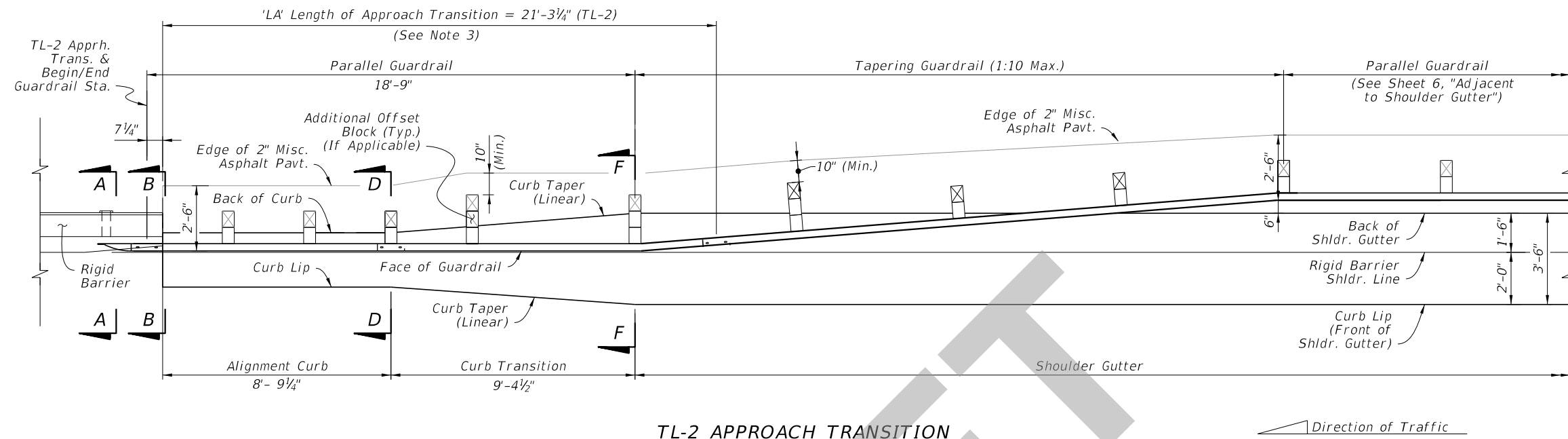
- INSTALLATION:** Construct the Approach Transition segment where indicated in the plans. For example Layouts showing the Approach Transition's fit among other guardrail segments, see Sheet 19.

For existing bridge connection options, see Indexes 536-002, 521-404, and 521-405.
- SECTION VIEWS & DETAILS:** For cross sections and details, including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 17.
- GUARDRAIL TAPER:** The connecting guardrail may require a different lateral offset if shown in the plans. At the location indicated herein, taper the guardrail to the connecting guardrail offset. If the adjacent guardrail segment has the same offset as the Approach Transition segment, then no taper is required.
- END TRANSITION OF CURB OPTIONS:** The Plan and Elevation views depict an example Curb Transition to Flush Shoulder from Section D-D to E-E, but this transition may require a different shape depending on the End Transition option shown in the plans (Either a 'Shoulder Gutter Option', 'Raised Curb Option', or 'Flush Shoulder Option'). See Sheet 16 for additional curb options and Sheet 17 for curb shape details.
- RIGID BARRIER END TRANSITION:** Taper the Rigid Barrier toe as shown. See Concrete Barrier, Index 521-001, and Traffic Railing, Indexes 521-422 and 521-428, for details.
- OFFSET:** The required offset difference between the Face of Guardrail and Rigid Barrier Shoulder Line is considered negligible and may not be shown in the guardrail offset callouts in the plans. A consistent guardrail offset deviation of up to 4 inches outside of the Rigid Barrier Shoulder Line is permitted over the length 'LA'.
- GENERAL GUARDRAIL:** General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. Approach Terminals, Low-Speed Guardrail, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.

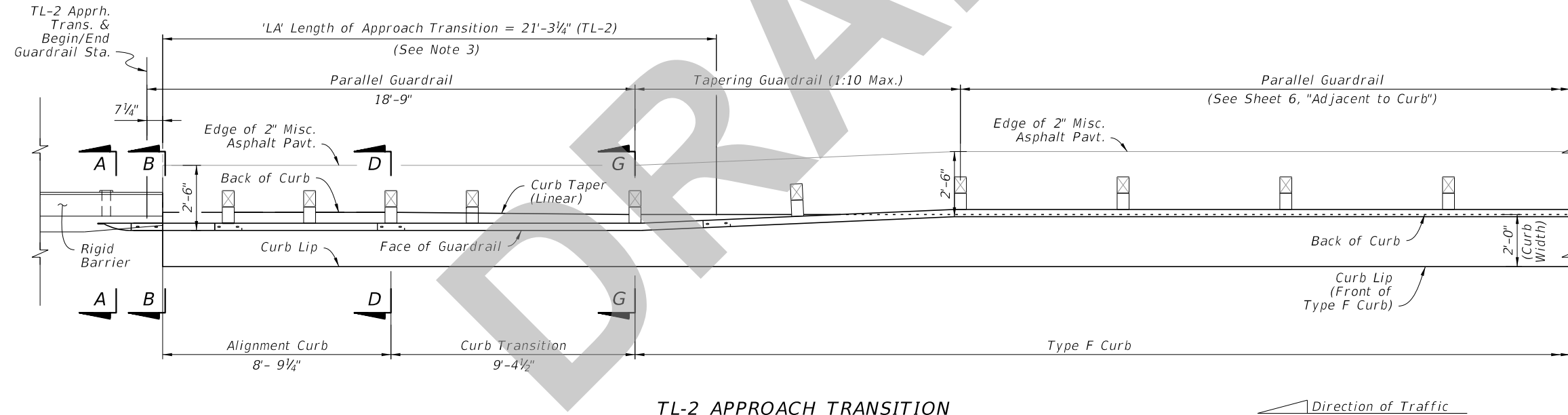
**APPROACH TRANSITION CONNECTION
TO RIGID BARRIER - LOW-SPEED, TL-2**

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TL-2 APPROACH TRANSITION WITH 'SHOULDER GUTTER' CONNECTION - PLAN VIEW




TL-2 APPROACH TRANSITION WITH 'TYPE F CURB' CONNECTION - PLAN VIEW

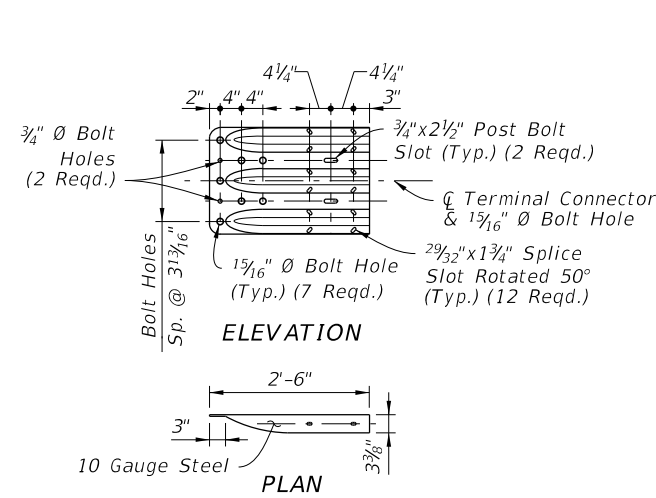
NOTES:

1. GENERAL: See the applicable notes and details on Sheet 15.
2. SECTION VIEWS & DETAILS: For cross sections and details, including the barrier mounting hardware, curb transition, adjacent grading, and installation dimensions, see Sheet 17.
3. ELEVATION VIEW: For post and panel installation details within 'LA', see the elevation view on Sheet 15. The curb details will differ depending on curb option required.

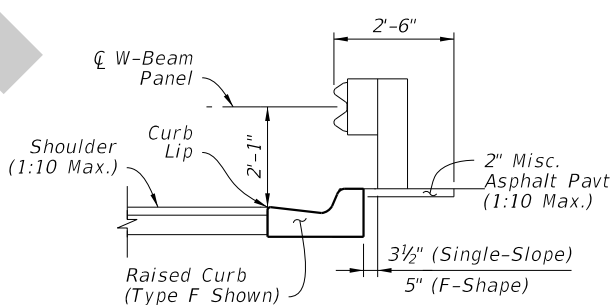
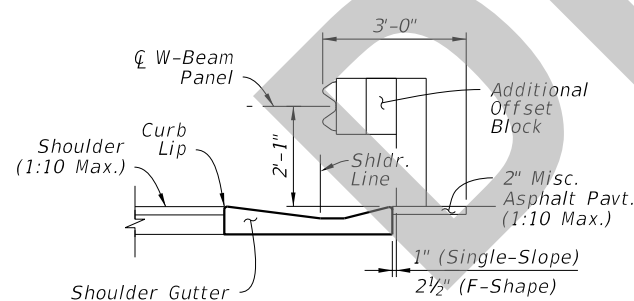
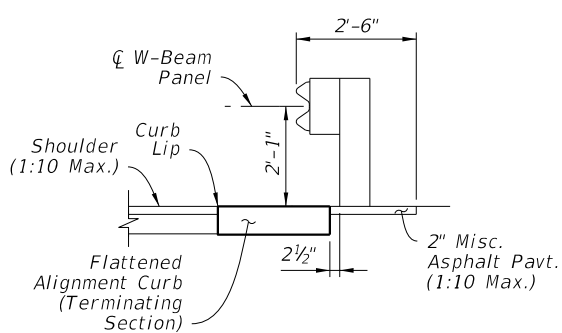
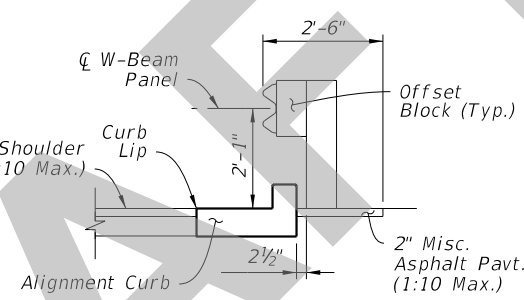
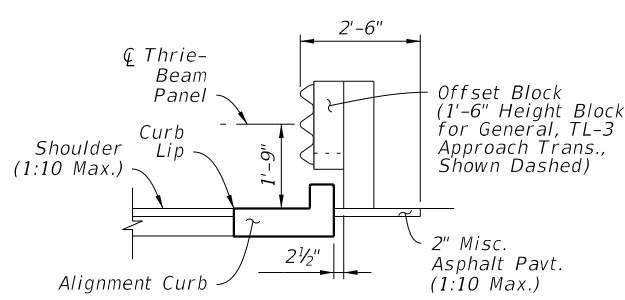
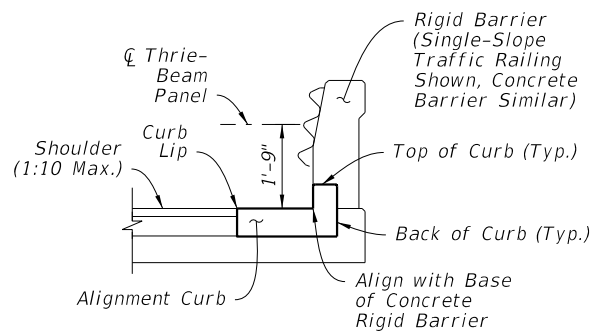
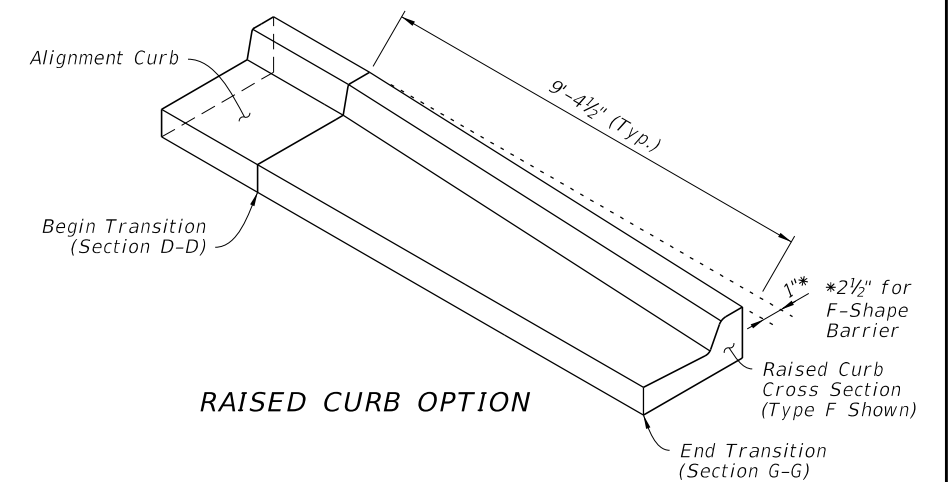
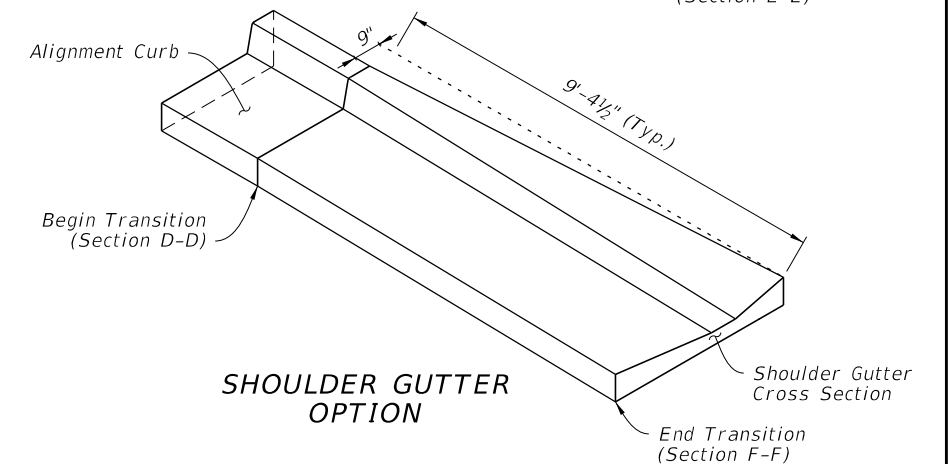
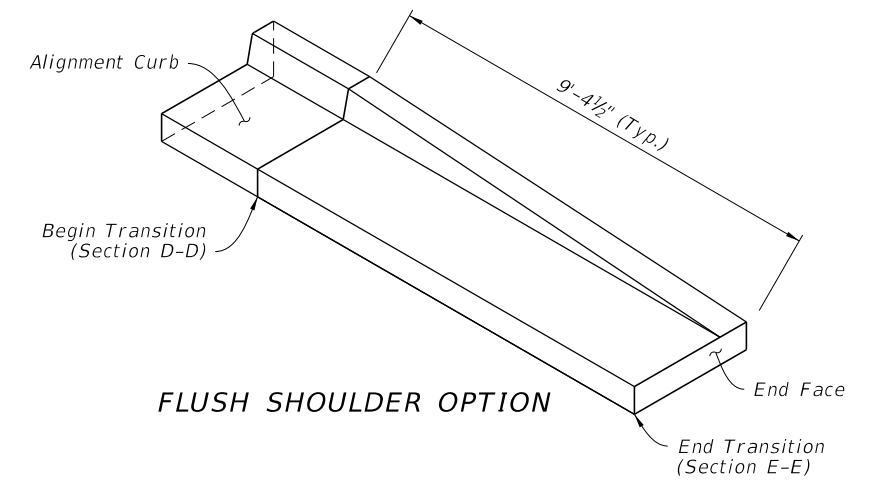
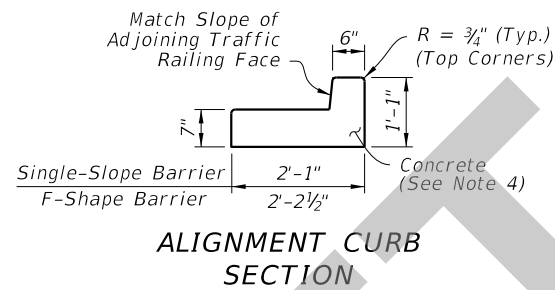
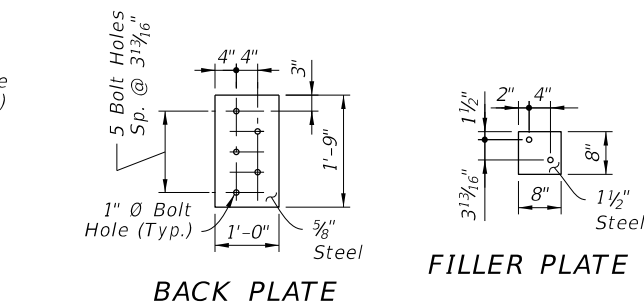
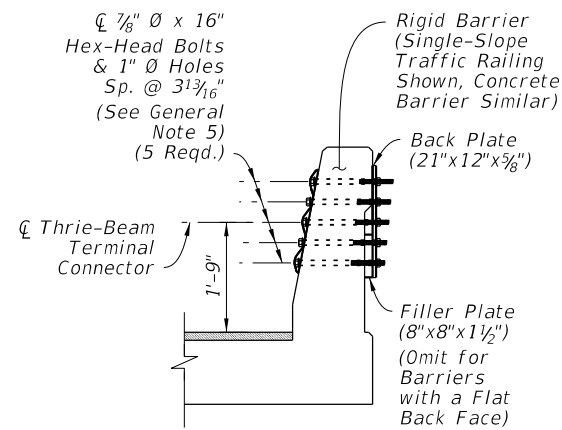
APPROACH TRANSITION CONNECTION TO RIGID BARRIER - LOW-SPEED, TL-2 CURB CONNECTIONS

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THRIE-BEAM TERMINAL CONNECTOR DETAIL



CURB TRANSITION ISOMETRIC VIEWS

NOTES:

1. PLAN AND ELEVATION VIEWS: Work with Sheets 13 thru 16.
2. END TRANSITION OF CURB OPTION: Install one of the three End Transition types shown per Section E-E as indicated by the plans.
3. GRADING BEHIND POSTS: Place Slope Break a Min. 2'-0" behind the post, per Sheet 6.
4. MATERIALS & CONSTRUCTION: Construct the concrete Aligning Curb and Curb transition in accordance with Specification 520. Use steel Plates and Thrie-Beam Terminal Connectors in accordance with Specification 967.

CURB TYPICAL SECTIONS

APPROACH TRANSITION CONNECTION - DETAILS

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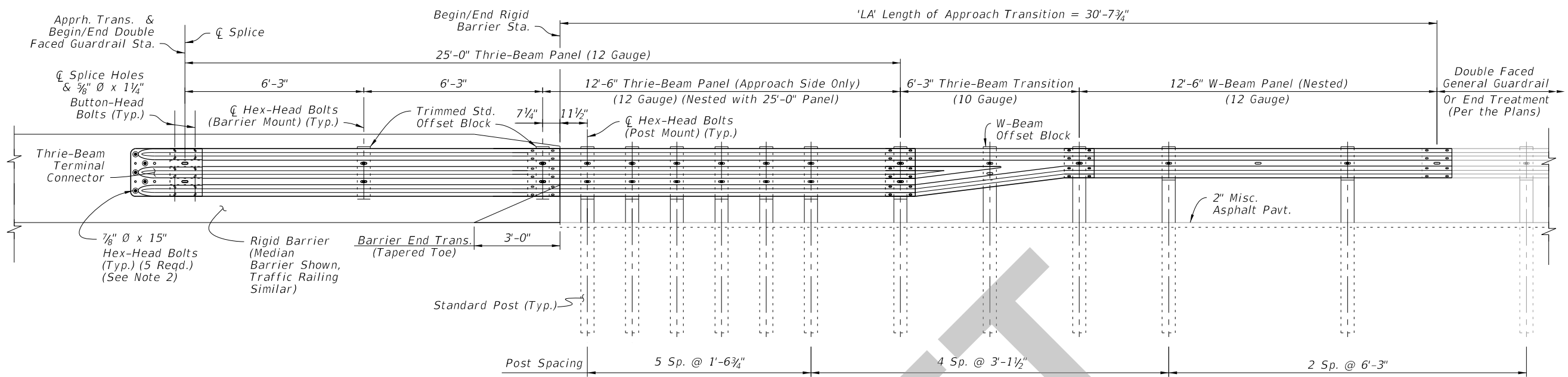
LAST REVISION 11/01/19	DESCRIPTION:
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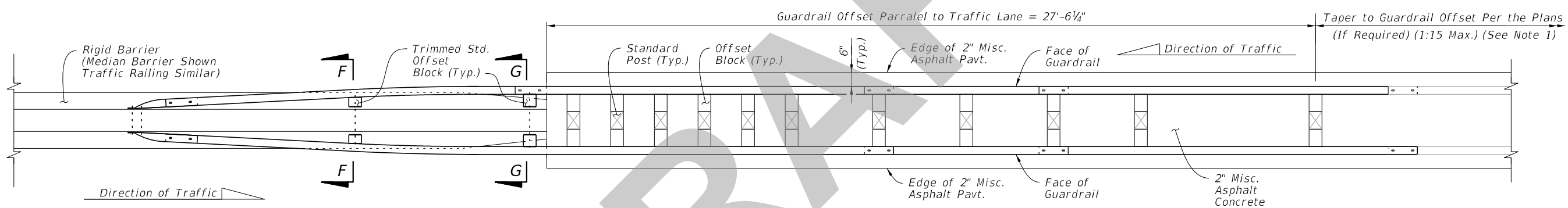
FY 2019-20
STANDARD PLANS

GUARDRAIL

INDEX SHEET
536-001 17 of 24

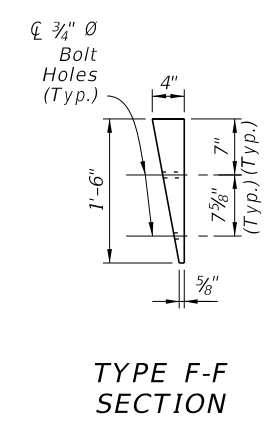


**TL-3 DOUBLE FACED APPROACH TRANSITION
INSTALLED ELEVATION**

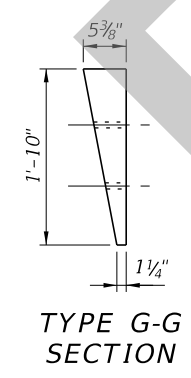


**TL-3 DOUBLE FACED APPROACH TRANSITION
INSTALLED PLAN**

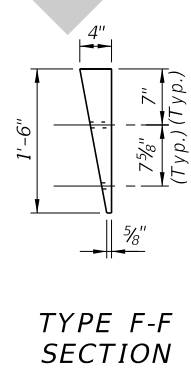
- NOTES:**
- INSTALLATION:** Construct the Approach Transition segment where indicated in the plans. The required offset of the connecting adjacent guardrail is shown in the plans.
The Layout given on Sheet 20 provides a basic scheme for connections to adjacent guardrail, where a taper to a differing guardrail offset may be required. If the adjacent guardrail has the same offset as the Approach Transition segment, then no taper is required.
 - THRIE-BEAM TERMINAL CONNECTOR:** See Sheet 17 for Details. The installed bolt's threaded portion is not permitted to extend beyond $\frac{3}{4}$ " from the face of the nut; trim the threaded portion as needed and galvanize in accordance with Specification 562.
 - GENERAL GUARDRAIL:** General Guardrail typically includes Panels and Post Spacing as shown on Sheet 2, including parallel and tapered segments. End Treatments or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail shown herein if indicated in the plans.



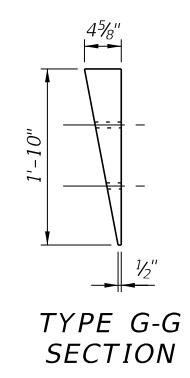
**TYPE F-F
SECTION**



**TYPE G-G
SECTION**

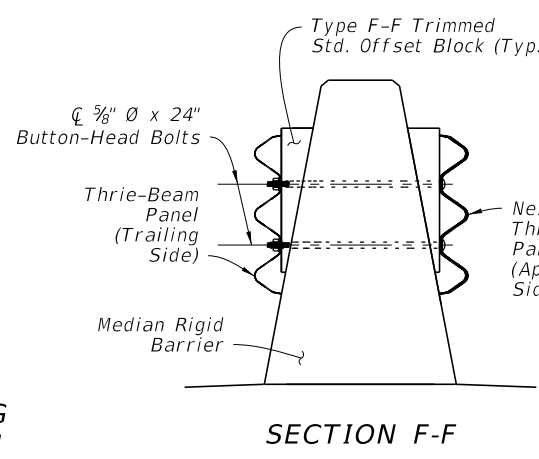


**TYPE F-F
SECTION**

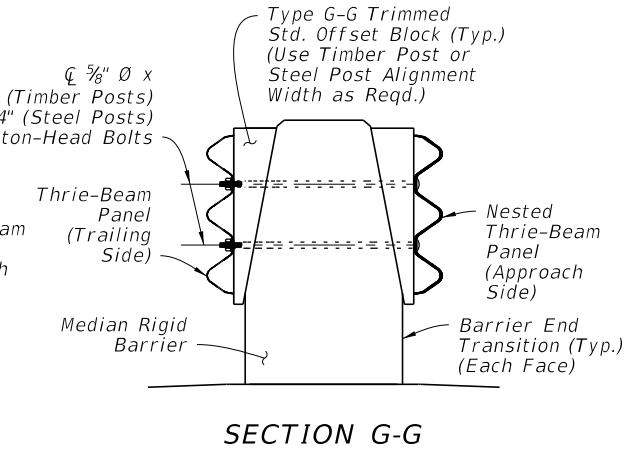


**TYPE G-G
SECTION**

==== TRIMMED STD. OFFSET BLOCKS TIMBER POST ALIGNMENT WIDTH
==== TRIMMED STD. OFFSET BLOCKS STEEL POST ALIGNMENT WIDTH



SECTION F-F

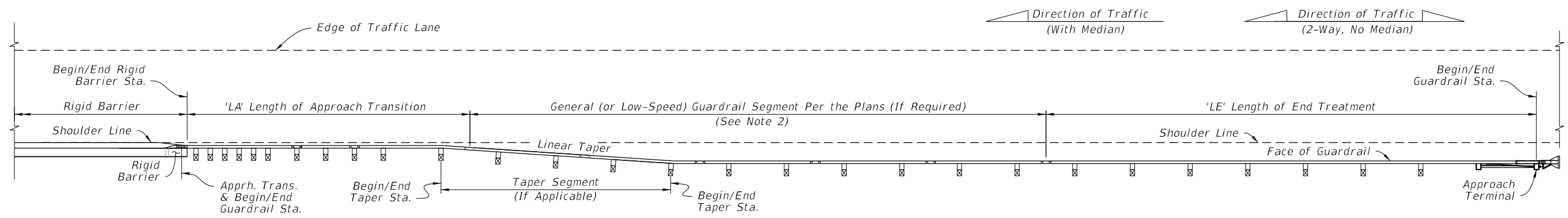


SECTION G-G

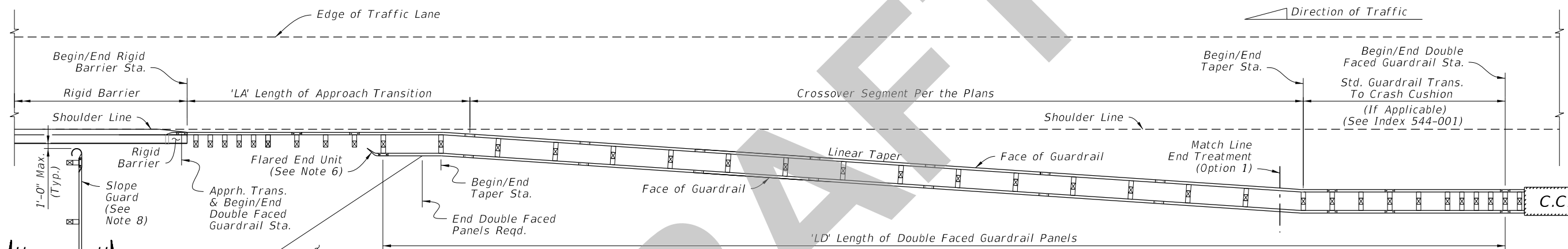
**APPROACH TRANSITION CONNECTION TO
RIGID BARRIER WITH DOUBLE FACED GUARDRAIL**

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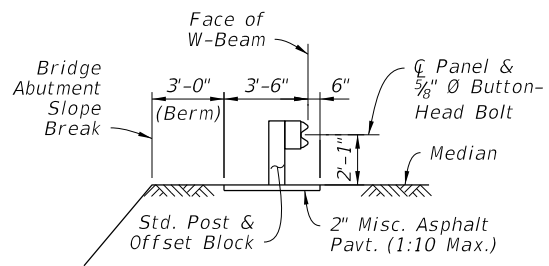
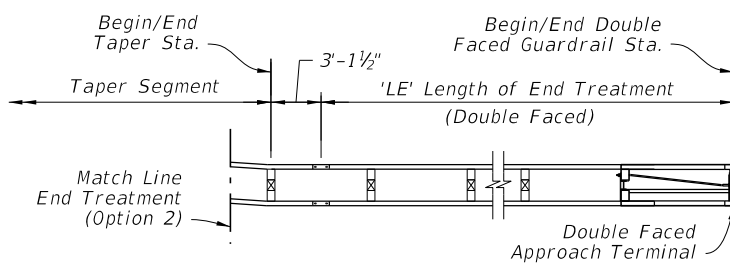
LAST REVISION 11/01/19	DESCRIPTION:		FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX 536-001	SHEET 18 of 24



TYPE A APPROACH TO RIGID BARRIER - PLAN VIEW
MEDIAN OR OUTSIDE SHOULDERS
 (Mirror Horiz. and/or Vert. for Opposite
 Direction and/or Side of Road)



TYPE B APPROACH TO RIGID BARRIER - PLAN VIEW
CROSSOVER GUARDRAIL FOR MEDIAN SHOULDERS ONLY
DUAL BRIDGE APPROACH CONFIGURATION
 (Mirror Horiz. and Vert. for Opposite Direction)



SECTION H-H
BRIDGE ABUTMENT
SLOPE GUARD
(Between Bridges)

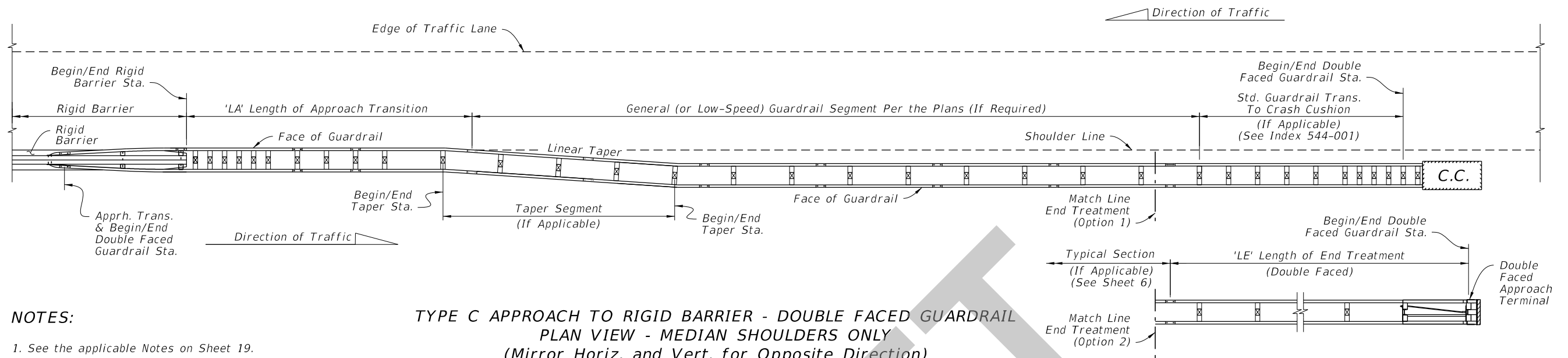
NOTES:

- INSTALLATION:** The Plan Views shown are schematic only, showing example geometry for connecting guardrail segments including taper locations and Double Faced Guardrail requirements as applicable. Work this Sheet with the plans, where stationing and offsets for Begin/End Guardrail, Begin/End Rigid Barrier, and Begin/End Taper are specified. For existing bridge layouts, see Index 536-002, 521-404, and 521-405.
- GENERAL (OR LOW-SPEED) GUARDRAIL SEGMENT:** Construct this segment if shown in the plans. For the case where this segment's offset differs from the Approach Transition offset, linearly taper the guardrail between the Begin/End Taper Stations and offsets as specified in the plans.
For the shortest length case of a direct connection between the End Treatment and the Approach Transition, this segment may be omitted as shown in the plans.
- LENGTH OF APPROACH TRANSITION 'LA':** Install the applicable Approach Transition as shown per Sheets 13 thru 16, where called for in the plans.
- LENGTH OF END TREATMENT 'LE':** Install the Approach Terminal End Treatment as shown per Sheet 7 or 8, where called for in the plans. Use the corresponding APL drawings for construction details.
- CROSSOVER GUARDRAIL (FOR TYPE B APPROACH):** Install the Crossover Segment tapering linearly from the Begin Taper Sta. and offset to the End Taper Sta. and offset as specified in the plans.
- LENGTH OF DOUBLE FACED GUARDRAIL PANELS, 'LD' (FOR TYPE B APPROACH):** Terminate the Double Faced Guardrail panels as shown (based upon the 30° line measured from the hazard on the opposite side of the median). Extend the panel segment longer than the dimension 'LD' as needed for the Panel's end Bolt Slot to align with a post Bolt hole.
Install a Flared End Unit where shown, as defined on Sheet 9.
- END TREATMENT OPTIONS (FOR TYPE B & C APPROACH):** For Double Faced applications, use either a Double Faced Approach Terminal Assembly per Sheet 8 or a Crash Cushion per Index 544-001. For either Option, meet the 1:10 adjacent grading requirements for Approach Terminals as shown on Sheet 8.
- SLOPE GUARD:** Where indicated in the plans, install a Guardrail segment between bridge approaches and offset from the bridge abutment's Slope Break as shown. Install posts at the end bolt slots of the panel system. Use post spacing of either 3'-1 1/2" or 6'-3", as needed to correctly fit system between barriers. The system may also be lengthened to fit by installing two Rounded End Units as defined on Sheet 9.

LAYOUT TO RIGID BARRIER -
APPROACH ENDS

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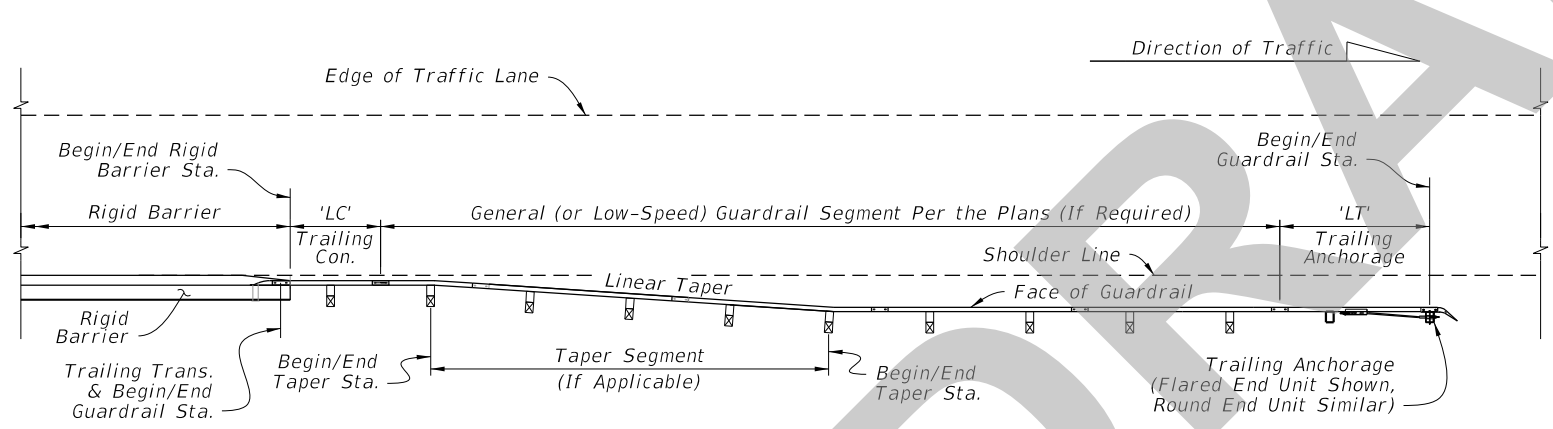


NOTES:

1. See the applicable Notes on Sheet 19.

**TYPE C APPROACH TO RIGID BARRIER - DOUBLE FACED GUARDRAIL
PLAN VIEW - MEDIAN SHOULDERS ONLY
(Mirror Horiz. and Vert. for Opposite Direction)**

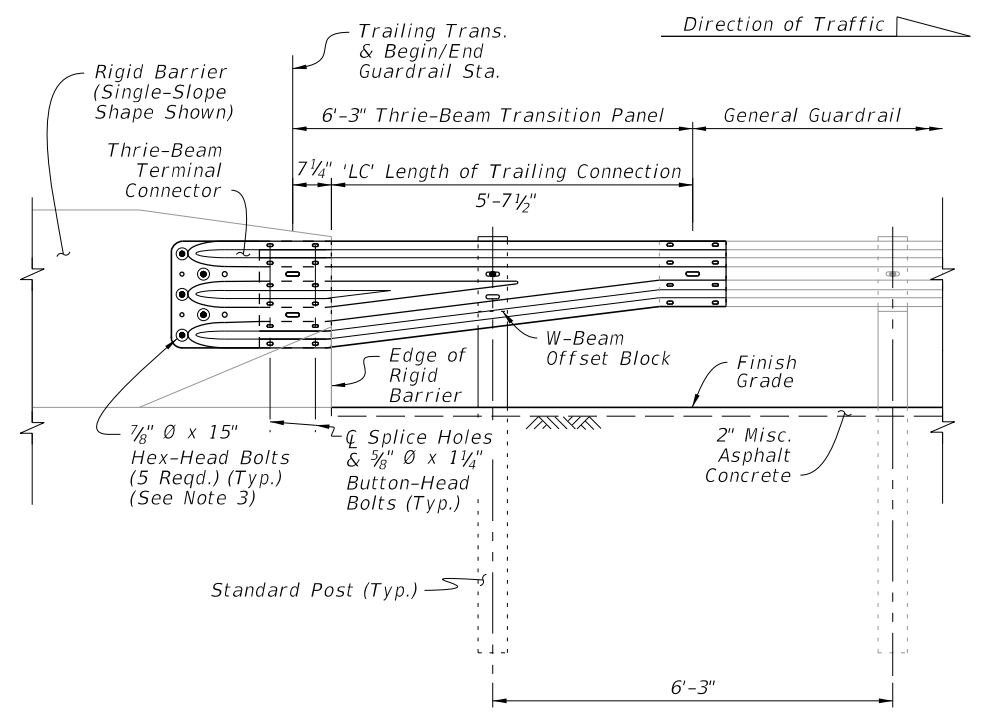
**LAYOUT TO RIGID BARRIER -
APPROACH ENDS WITH
DOUBLE FACED GUARDRAIL**



**TYPE D TRAILING CONNECTION FROM RIGID BARRIER
PLAN VIEW - MEDIAN OR OUTSIDE SHOULDER
(Mirror Horiz. and/or Vert. for Opposite
Direction and/or Side of Road)**

NOTES:


1. See the applicable Notes on Sheet 19.
2. LENGTH OF TRAILING ANCHORAGE, 'LT': Install the Trailing Anchorage as shown on Sheet 9, where called for in the plans.
3. THRIE-BEAM TERMINAL CONNECTOR: Install connector and bolts as shown on Sheet 17.
4. RIGID BARRIER SINGLE SLOPE END FACE: See Concrete Barrier Wall, Index 521-001, and Traffic Railing, Indexes 521-422 and 521-423, for details.

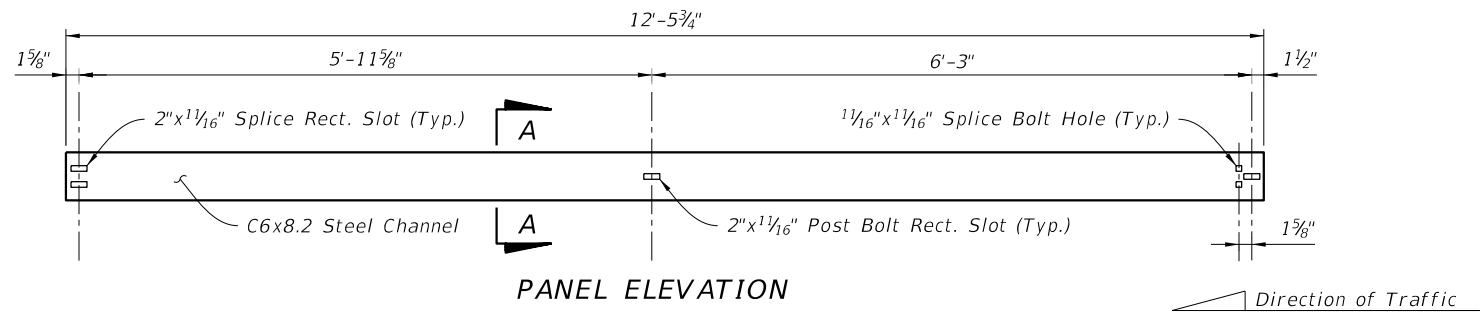


**TRAILING END TRANSITION CONNECTION
TO RIGID BARRIER - INSTALLED ELEVATION**

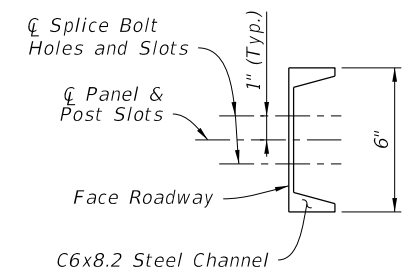
**LAYOUT TO RIGID BARRIER -
TRAILING ENDS**

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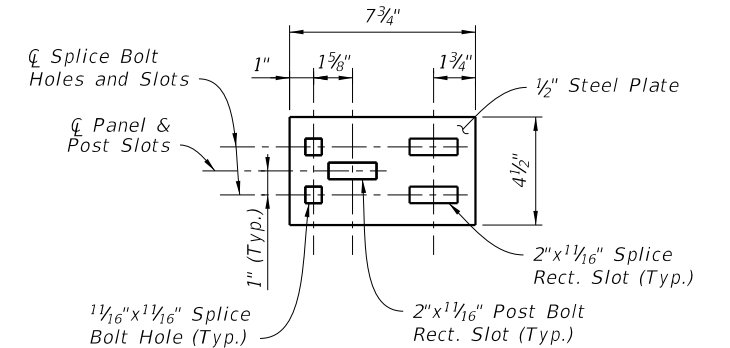
LAST REVISION 11/01/19	REVISION	DESCRIPTION:	 FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX 536-001	SHEET 20 of 24
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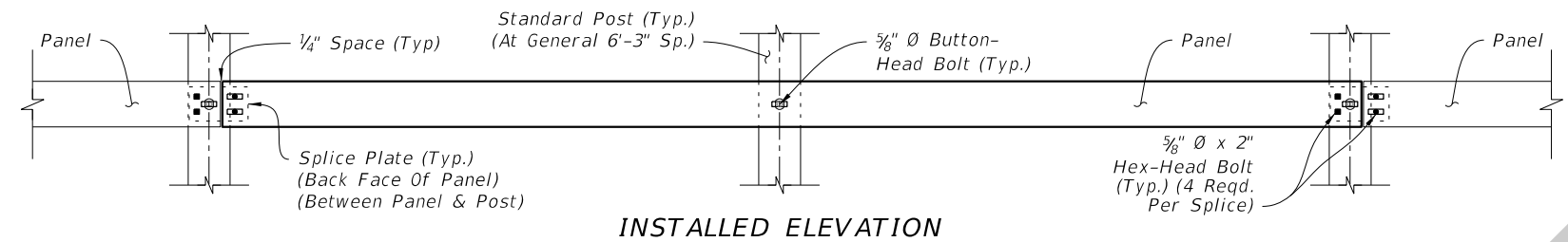
PANEL ELEVATION



SECTION A-A
(Panel Typical)

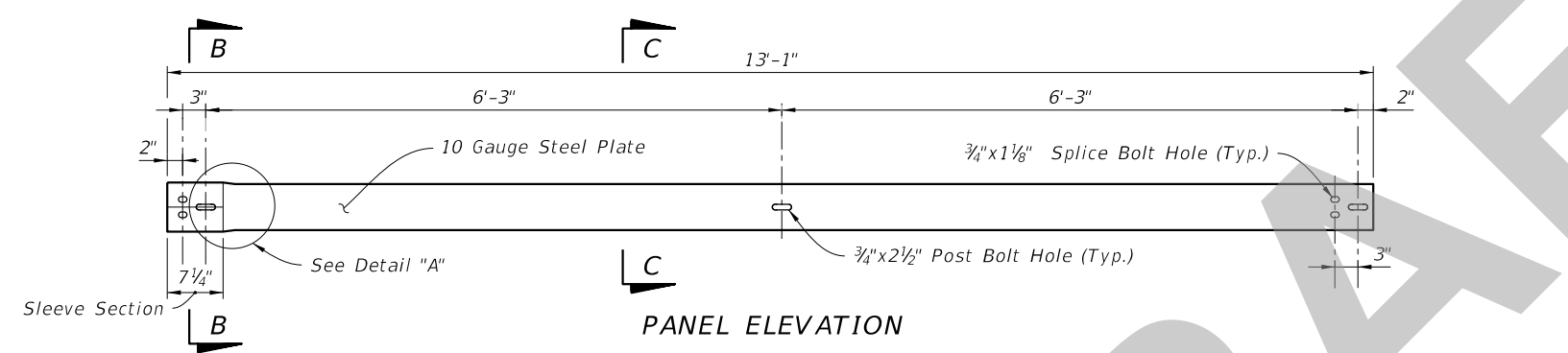


SPLICE PLATE ELEVATION

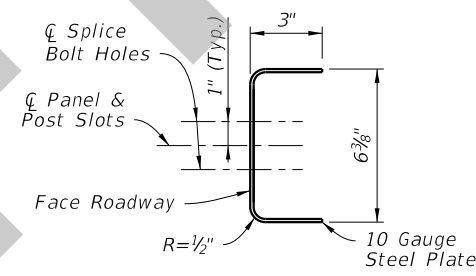


INSTALLED ELEVATION

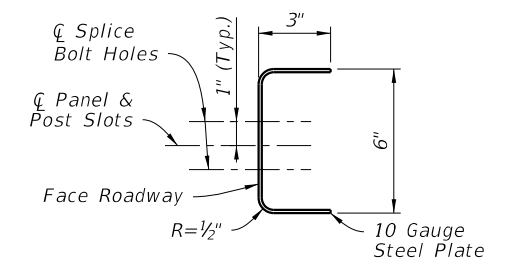
CHANNEL SECTION RUB RAIL



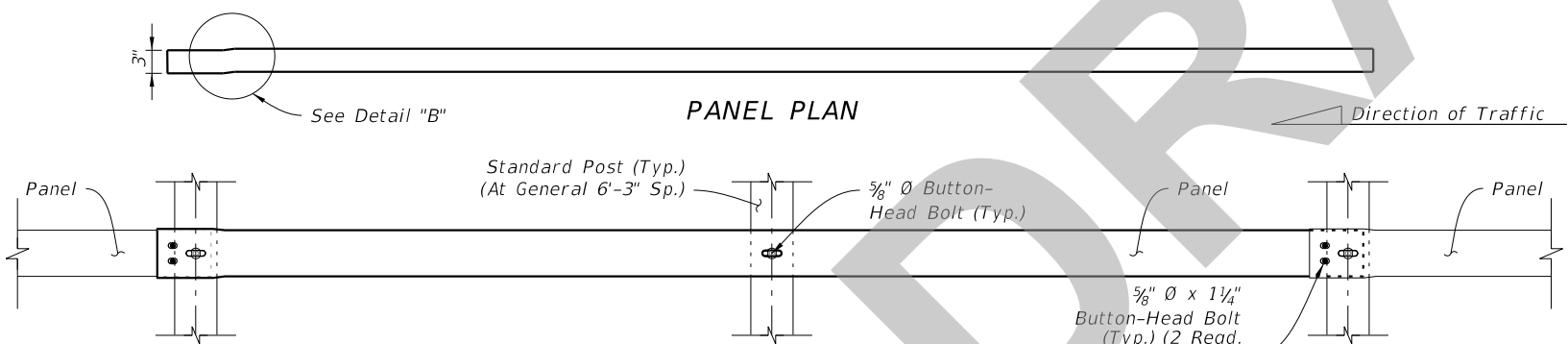
PANEL ELEVATION



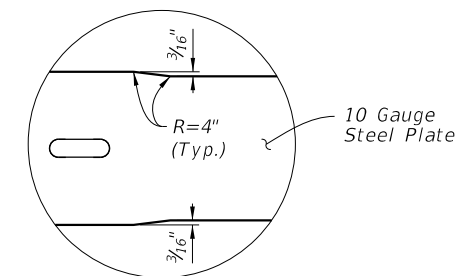
SECTION B-B
(Panel Sleeve End)



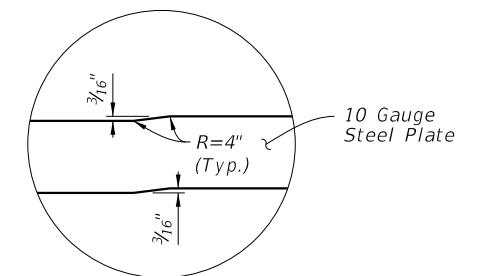
SECTION C-C
(Panel Typical)



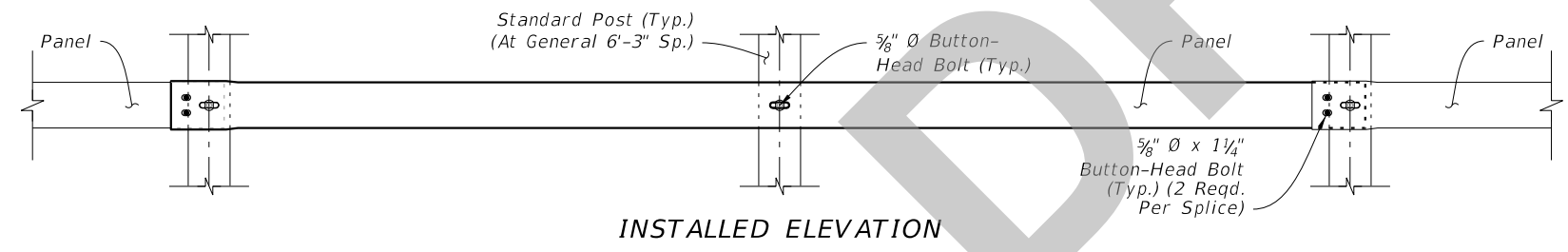
PANEL PLAN



DETAIL "A"
(Sleeve Transition Elevation)

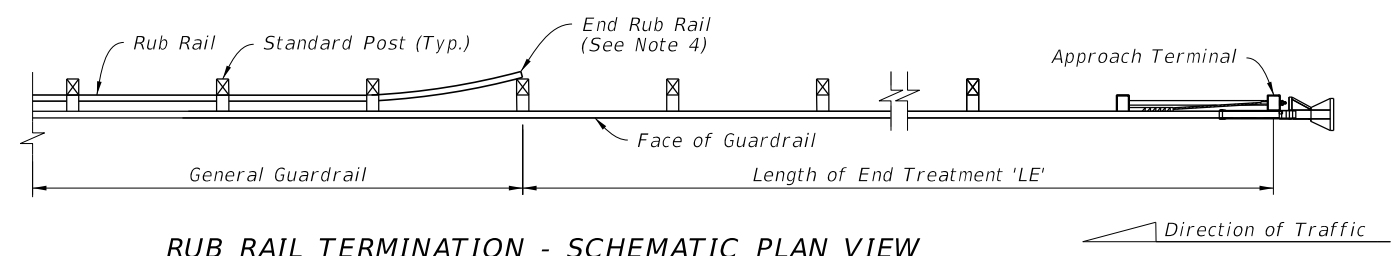


DETAIL "B"
(Sleeve Transition Plan)



INSTALLED ELEVATION

BENT-PLATE PANEL RUB RAIL



RUB RAIL TERMINATION - SCHEMATIC PLAN VIEW

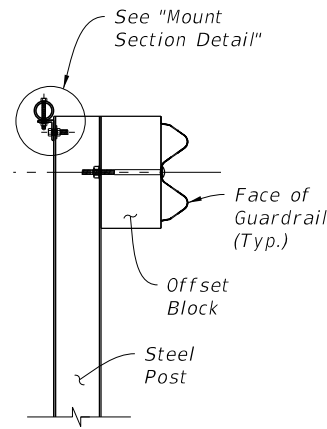
NOTES:

1. GENERAL: Install Rub Rail where called for in the plans. Position as shown on Sheet 6 unless otherwise shown in the plans. Install the backs of Rub Rail panels flush against Standard Posts. Either of the Channel Section or Bent-Plate Panel Rub Rail options may be used (consistent type per project). Where Double Sided Rub Rail is called for, thread the Button-Head Bolt through the Post Bolt Hole(s) and the panels on either side, and tighten the nut against the face of the panel farthest from adjacent traffic lanes. Trim the bolt's threaded portion in accordance with Note 4 on Sheet 5.
2. MOUNTING HEIGHT: Mount to the Standard Post's Rub Rail Bolt Hole as defined on Sheet 5.
3. MATERIALS: Use steel components in accordance with Specification 967.
4. END RUB RAIL: For Single Sided Rub Rail, terminate the run of Rub Rail by bending the panel behind the post and securing in place (as shown). For Double Sided Rub Rail, terminate the runs of Rub Rail on their respective front face of the post and secure with the typical Button-Head bolt.

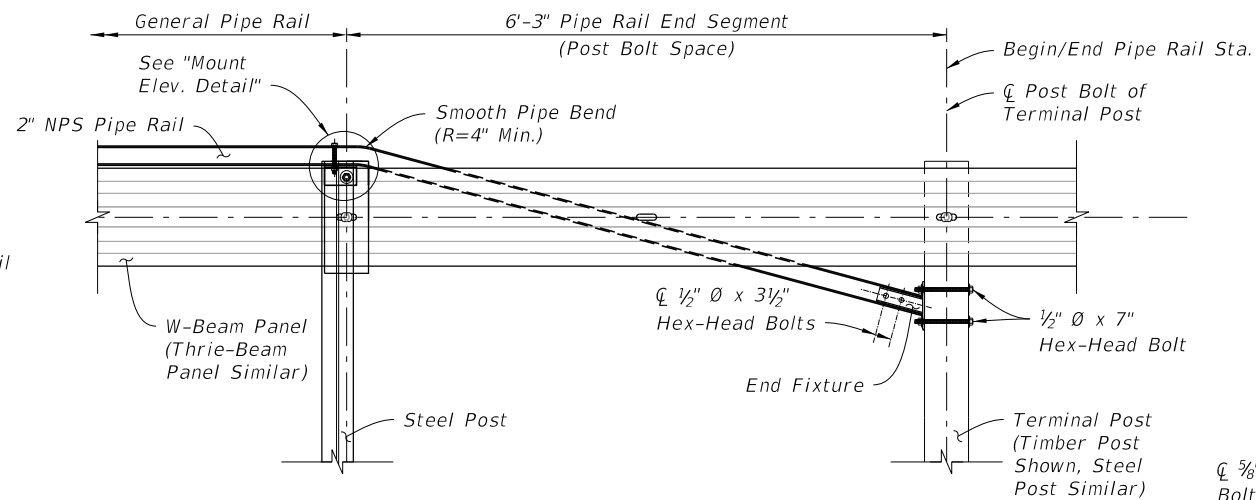
RUB RAIL DETAILS

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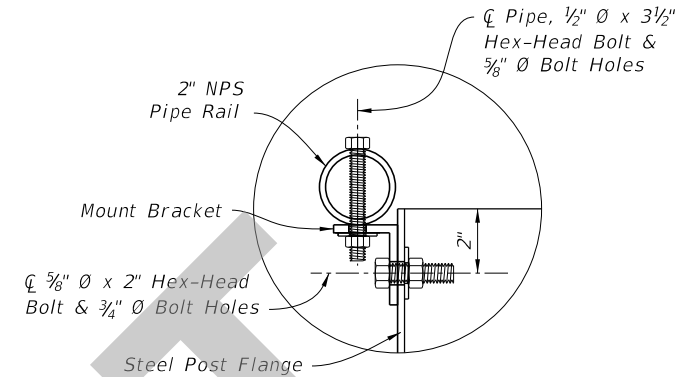
LAST REVISION 11/01/19	REVISION	DESCRIPTION:		FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX 536-001	SHEET 21 of 24
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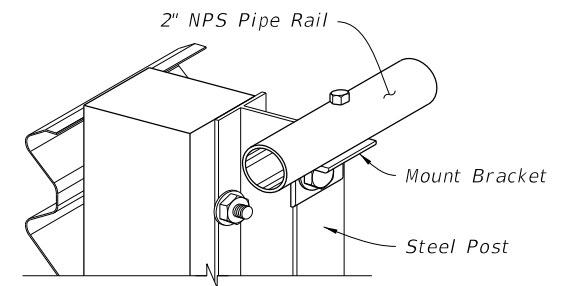
GENERAL PIPE RAIL SECTION



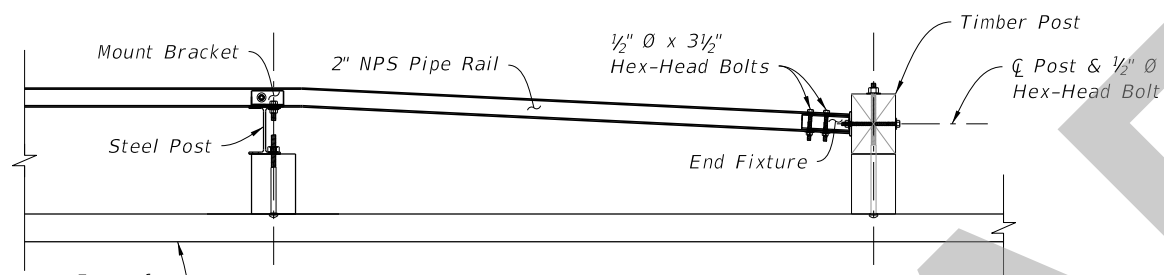
PIPE RAIL INSTALLED ELEVATION (End Segment Shown)



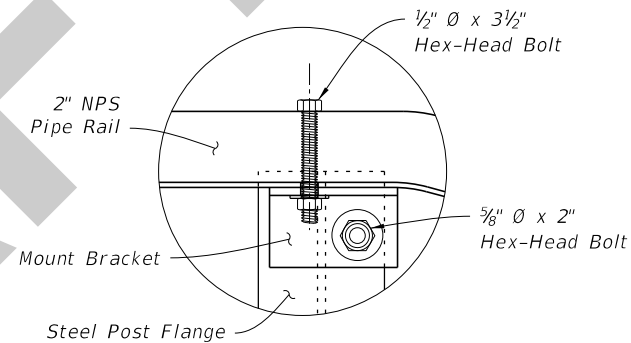
MOUNT SECTION DETAIL



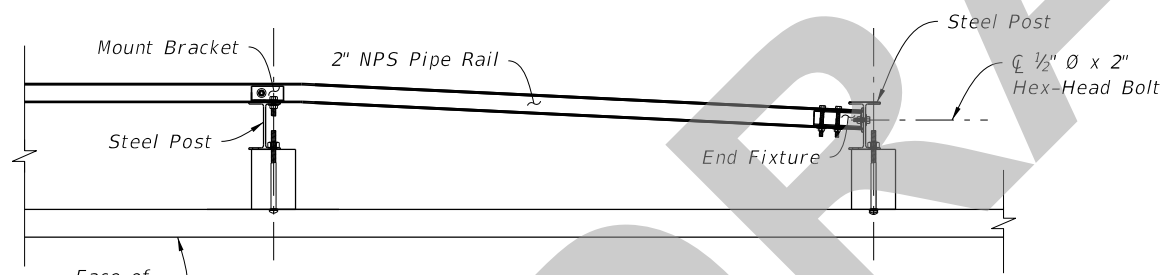
MOUNT ISOMETRIC CUT-AWAY



PIPE RAIL INSTALLED PLAN END AT TIMBER POST OPTION



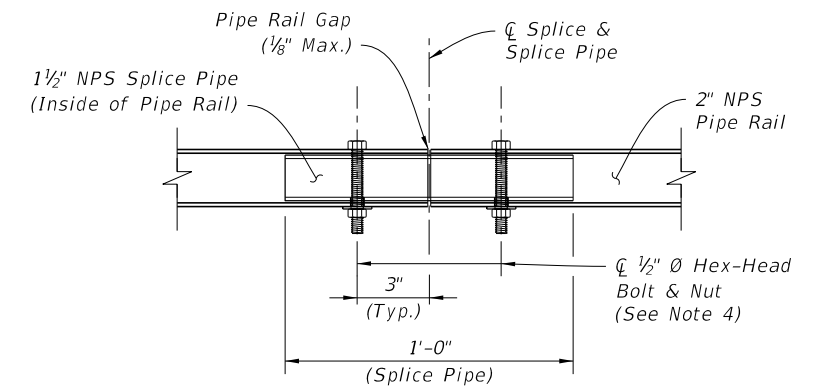
MOUNT ELEVATION DETAIL (Back View - Mirrored)



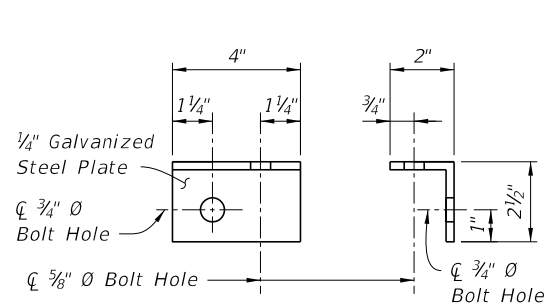
PIPE RAIL INSTALLED PLAN END AT STEEL POST OPTION

NOTES:

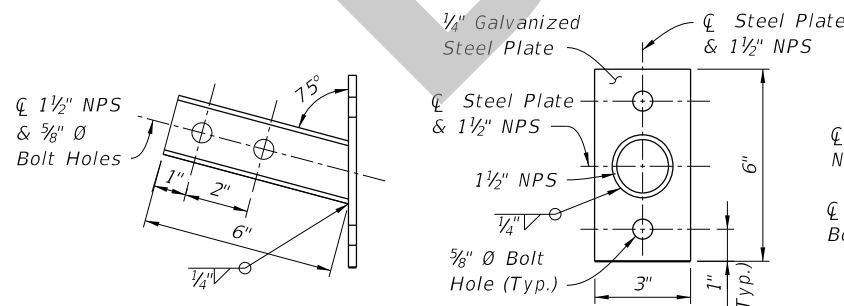
1. GENERAL: Install General Pipe Rail where indicated in the plans or when existing sidewalks or shared use paths are located less than 4'-0" from the back of Steel Posts as shown on Sheet 6.
2. PIPE RAIL END SEGMENTS: Place End Segments on both ends of General Pipe Rail runs, with End Fixtures mounted to Terminal Posts located outside of Approach Terminal Assembly ('LE'), Trailing Anchorage Assembly ('LT'), and Approach Transition ('LA') segments.
3. MATERIALS: Use steel brackets, fixtures, and pipes in accordance with Specification 967.
4. RAIL SPLICES: Install Rail Splices to join pieces of 2" NPS Pipe Rail into a continuous system. Place splices as needed, at a spacing of 18'-0" or greater. Orient the head of bolt on the top of the pipe.



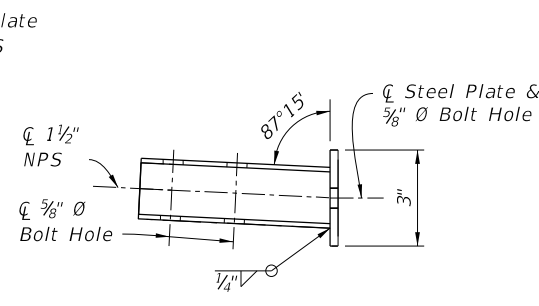
RAIL SPLICE DETAIL



ELEVATION SECTION



ELEVATION SECTION

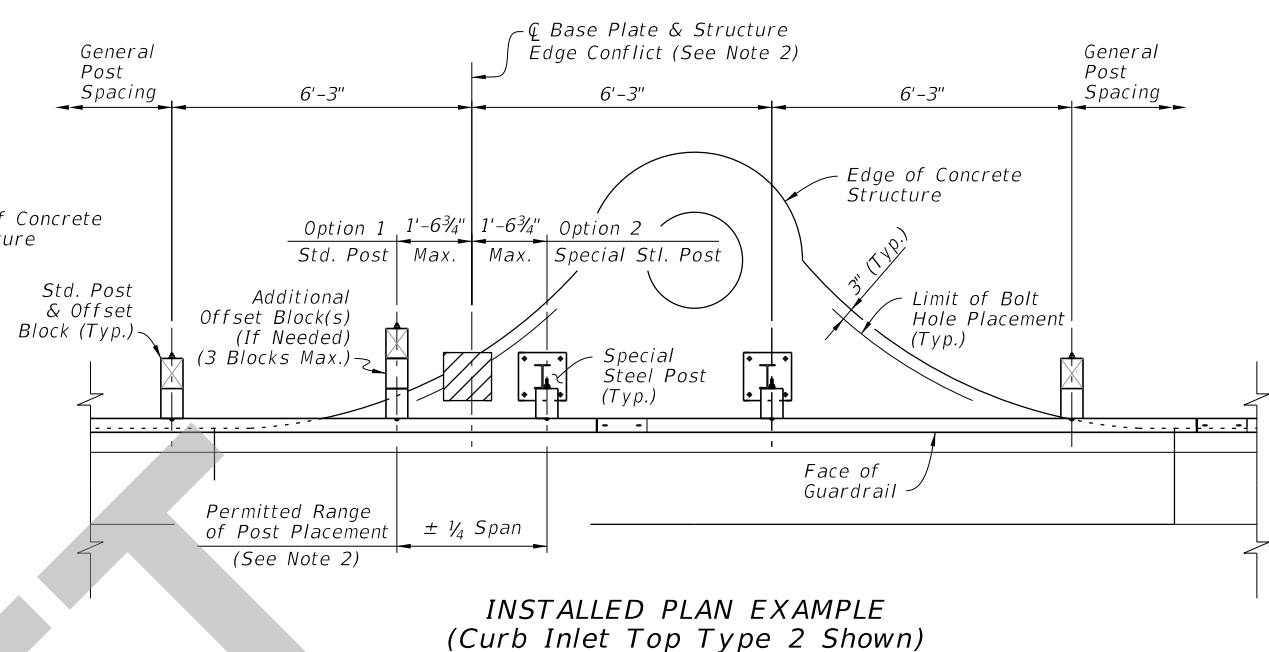
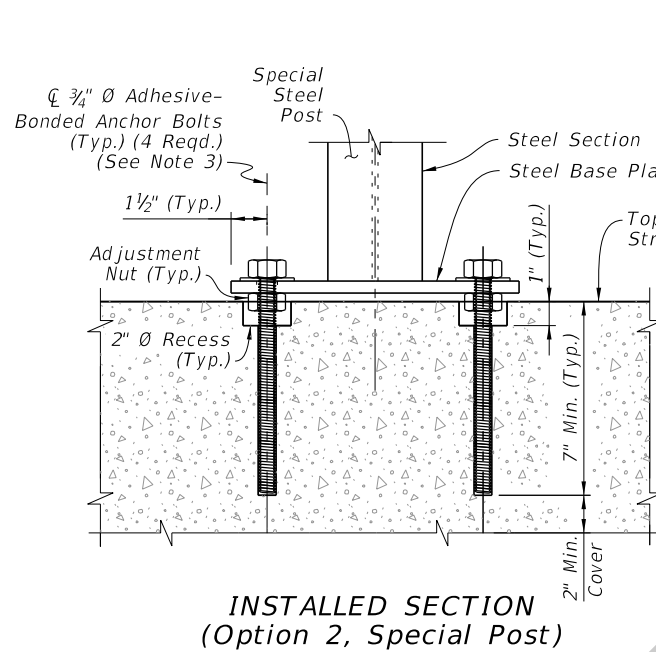
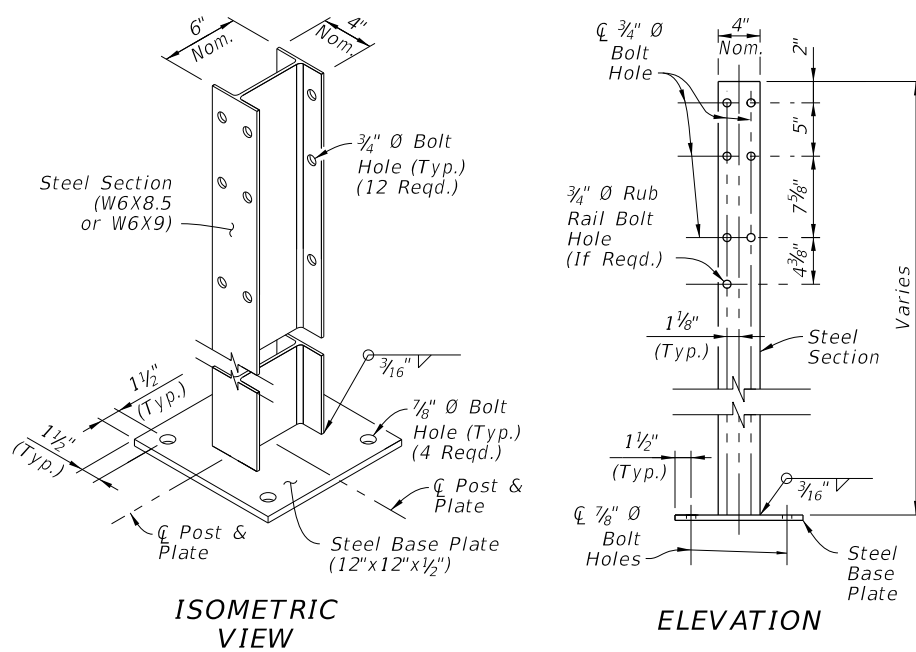


PLAN

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PEDESTRIAN SAFETY TREATMENT - PIPE RAIL

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SPECIAL STEEL POST

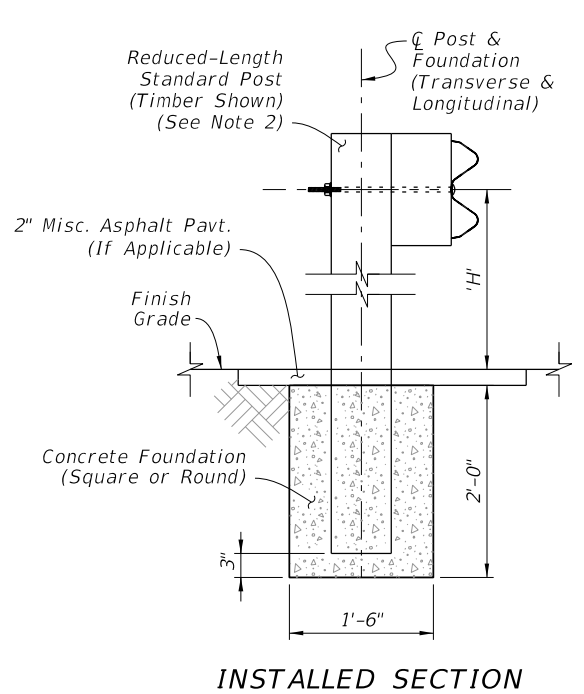
STRUCTURE MOUNTING

NOTES:

- INSTALLATION:** When the construction of Guardrail at the required post spacing results in post(s) located atop culverts, inlets, pier footings, or similar concrete structures, a Special Steel Post may be substituted for a Standard Post. Install where shown in the plans and/or as-needed, in accordance with Specification 536.
- EDGE CONFLICT:** When a required post location causes an Edge Conflict with the structure, where the Steel Base Plate is not located entirely on the structure at least 3" from the Edge of Concrete, the longitudinal post location may be altered by up to 1'-6 3/4" (Quarter Span) from the original required spacing location to prevent the Edge Conflict. With the post location adjusted, use a Std. Post mounted in soil (Option 1) or a Special Steel Post with its Base Plate mounted entirely on the structure (Option 2). Maintain the original required spacing locations upstream and downstream of the structure.

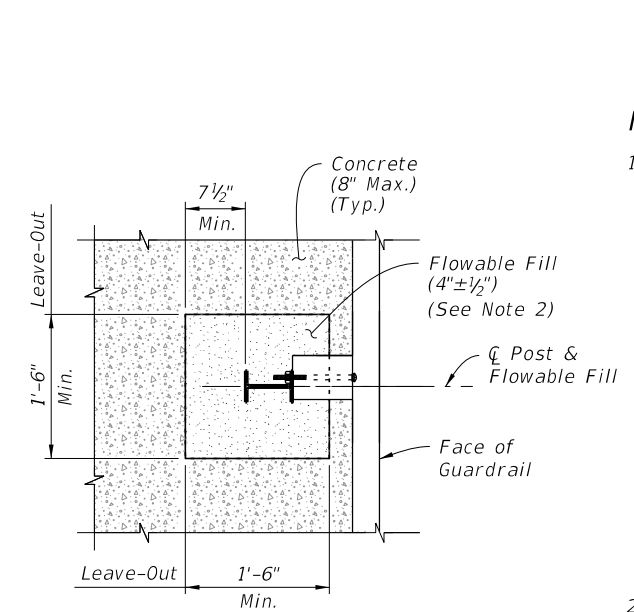
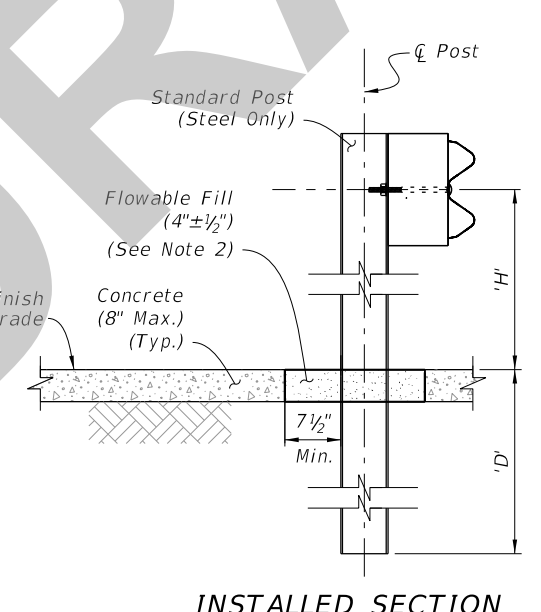
- BASE PLATE MOUNT:** Install Special Steel Posts as shown using steel Adhesive-Bonded Anchor Bolts in accordance with Specification 536. Use 3/4" Hex-Head Bolts for structures less than 9" deep as defined in the Specification.
- PANEL MOUNT TO ADJUSTED POST:** Punch additional 3/4"x2 1/2" Post Bolt Slot(s) in the W-Beam or Thrie-Beam Panel only where needed to mount the panel to a post in an adjusted location. Meet the Panel Post Bolt Slots requirements of Specification 536.
- MATERIALS:** Use steel base plates in accordance with Specification 536.

SPECIAL STEEL POST FOR CONCRETE STRUCTURE MOUNT



NOTES:

- INSTALLATION:** When the construction of Guardrail at the required post spacing results in post(s) conflicting with underground utilities or other underground obstructions, an Encased Post may be used where a 2'-0" depth will avoid the conflict. Install where shown in the plans and/or as-needed, in accordance with Specification 536.
- REDUCED-LENGTH STANDARD POST:** Use a Standard Post with reduced Length such that the Panel Height 'H' is maintained while the post bottom terminates 3" from the bottom of the Concrete Foundation. Typically, the Post Length 'L' is 4'-7" for W-Beam Guardrail.
- FOUNDATION:** Use non-reinforced Class NS Concrete material in accordance with Specification 347. After casting the concrete, ensure the surrounding soil material is completely backfilled and tamped to provide full passive resistance.
- LIMIT:** Encased Posts are not permitted for more than 3 consecutive posts.



NOTES:

- INSTALLATION:** When the construction of Guardrail at the required post spacing results in post(s) placed within a concrete surface (typically a sidewalk), use a Frangible Leave-Out around the post base as shown. Install where shown in the plans and/or as-needed, in accordance with Specification 536.
Use Standard steel posts. Timber posts are not permitted for frangible leave-outs.
For the required 1'-6" x 1'-6" Leave-Out, smoothly cut the existing concrete surface or form-up the square shape when an application has new surrounding concrete.
Ensure Flowable Fill surface is smooth and even with the adjacent concrete surface.
- MATERIALS:** Use Non-Excavatable Flowable Fill in accordance with Specification 121, not to exceed 150 psi.

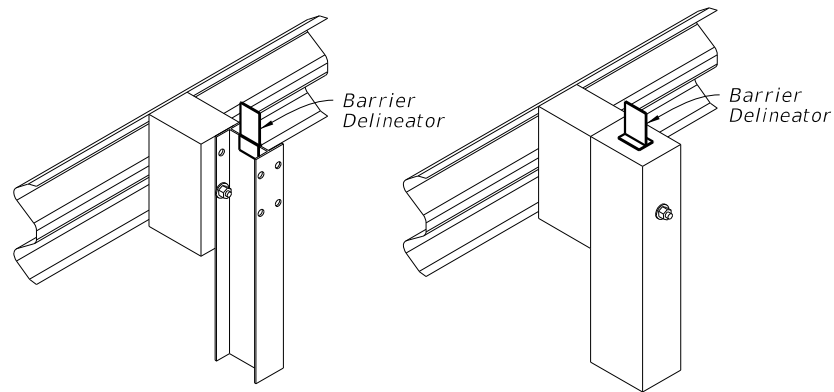
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LAST REVISION 11/01/19	REVISION	DESCRIPTION:	 FY 2020-21 STANDARD PLANS	GUARDRAIL	INDEX 536-001	SHEET 23 of 24
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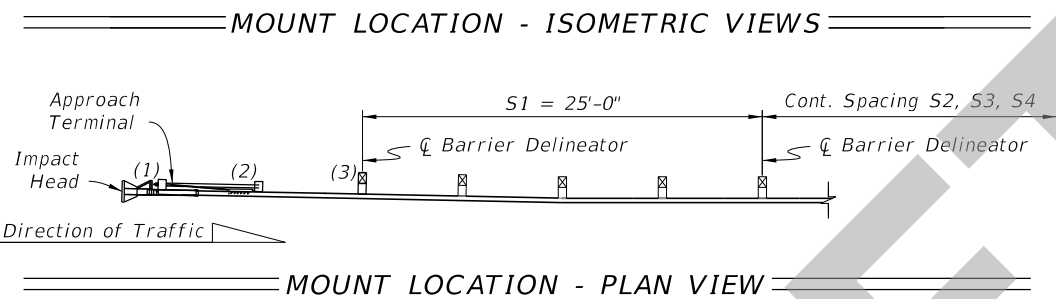
NOTES:

- INSTALLATION:** Install Barrier Delineators as shown in accordance with the plans, with Specifications 536 and 705, and with the manufacturer's design as approved on the APL.
- MATERIALS:** Use materials of the size and type defined for Barrier Delineators in Specification 993.
- COLOR:** Use either white or yellow retroreflective sheeting to match the color of the nearest lane's edgeline.
- MOUNT LOCATIONS:** Mount Barrier Delineators atop posts as shown, starting with Post (3) of Approach Terminals and incrementally increasing spacing towards the downstream direction. Install the Barrier Delineators at the following spacing:
 S1 = 25' x 1 Space
 S2 = 50' x 1 Space
 S3 = 75' x 1 Space
 S4 = 100' x for the Remaining Run

 Additionally, place a Barrier Delineator on Post (2) of the Trailing Anchorage or on the post nearest the Rigid Barrier.
- MEDIAN GUARDRAIL:** Install retroreflective sheeting on both sides of the barrier delineator for Guardrail on medians.



STEEL POSTS TIMBER POSTS

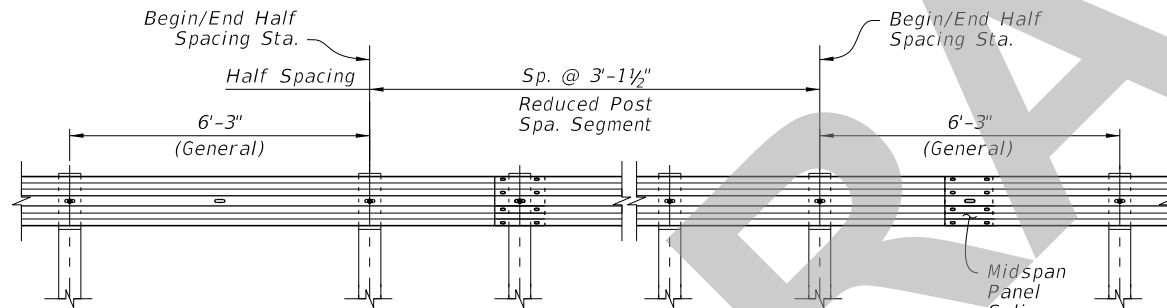


BARRIER DELINEATORS

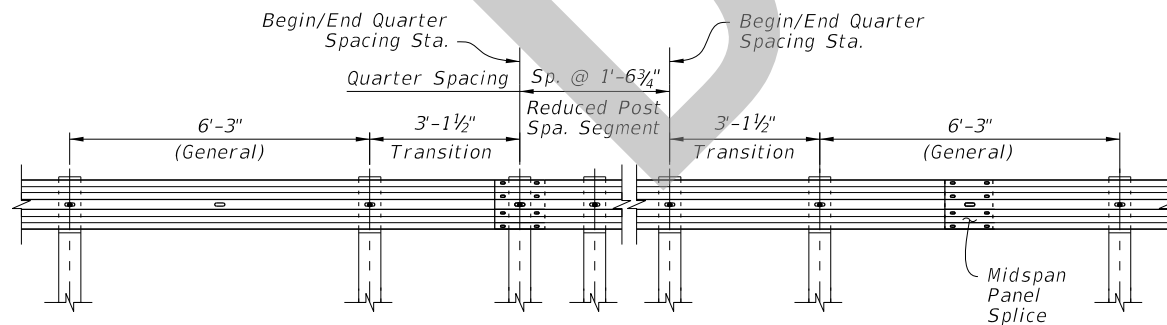
NOTES:

- INSTALLATION:** Work these details with the plans, where Stationing for Begin/End Half Spacing and Begin/End Quarter Spacing are indicated if required.

Where the Begin/End Stations indicated in the plans do not correspond exactly to post locations in construction, extend the Reduced Post Spacing segment to the nearest post(s) before the Begin Station and/or after the End Station called for.
- PANEL SPLICES:** Midspan Panel Splices are not required in Transition and Reduced Post Spacing segments, however they are required for General segments. To place midspan splices in General segments, use one Non-General panel length (9'-4 1/2" or 15'-7 1/2") or add an additional Transition spaced post where required.
- LOW-SPEED GUARDRAIL:** For Reduced Post Spacing with Low-Speed Guardrail (12'-6" post spacing), the Reduced Spacing pattern requires a 6'-3" space between the 12'-6" and 3'-1 1/2" spaces.
- PANEL POST BOLT SLOTS:** For Quarter Spacing configurations, punch additional 3/4"x2 1/2" Post Bolt Slots in the panels only where required for mounting and in accordance with Specification 536.

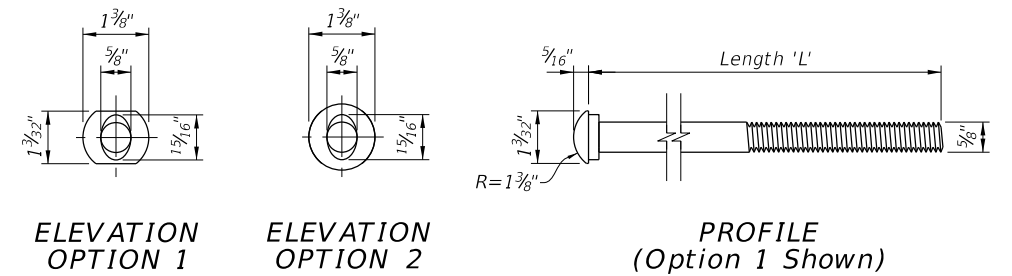


DETAIL 'S' - HALF SPACING ELEVATION
(AS REQD. PER THE PLANS)



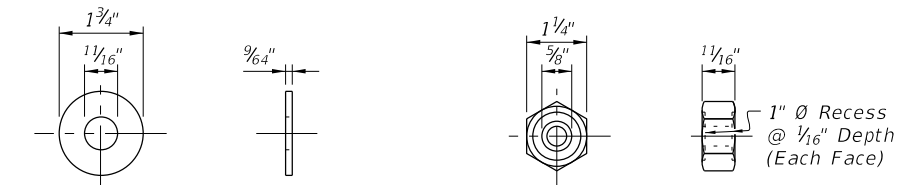
DETAIL 'S' - QUARTER SPACING ELEVATION
(AS REQD. PER THE PLANS)

REDUCED POST SPACING FOR HAZARDS



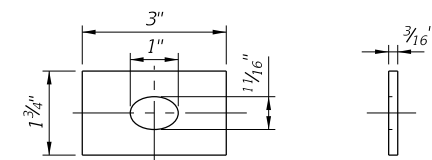
ELEVATION OPTION 1 ELEVATION OPTION 2 PROFILE (Option 1 Shown)

BUTTON-HEAD BOLT



ELEVATION PROFILE ELEVATION PROFILE

WASHER HEX-NUT



ELEVATION PROFILE

RECTANGULAR WASHER
(For CRT & Terminal Connectors Where Shown - Install Over Panel Face)

BUTTON-HEAD BOLT LENGTHS:

Application(s):	Length 'L':	Min. Thread Length:
Panel Splice	1 1/4"	Full Length
Steel Post Mount - Single Faced Guardrail	10"	4"
Timber Post Mount - Single Faced Guardrail	18"	4"
Steel or Timber Post Mount - Double Faced Guardrail	25"	4"

NOTES:

- Use nuts, bolts, and washers in accordance with Specification 967.
- For Steel Posts with Double Faced Guardrail, the single 25" Length bolt (one bolt thru both post flanges) may be replaced with two 10" Length bolts (one bolt per post flange).
- Use bolts listed in Table 2 in corresponding locations shown in this Index.

5/8" BUTTON-HEAD BOLT SYSTEM

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